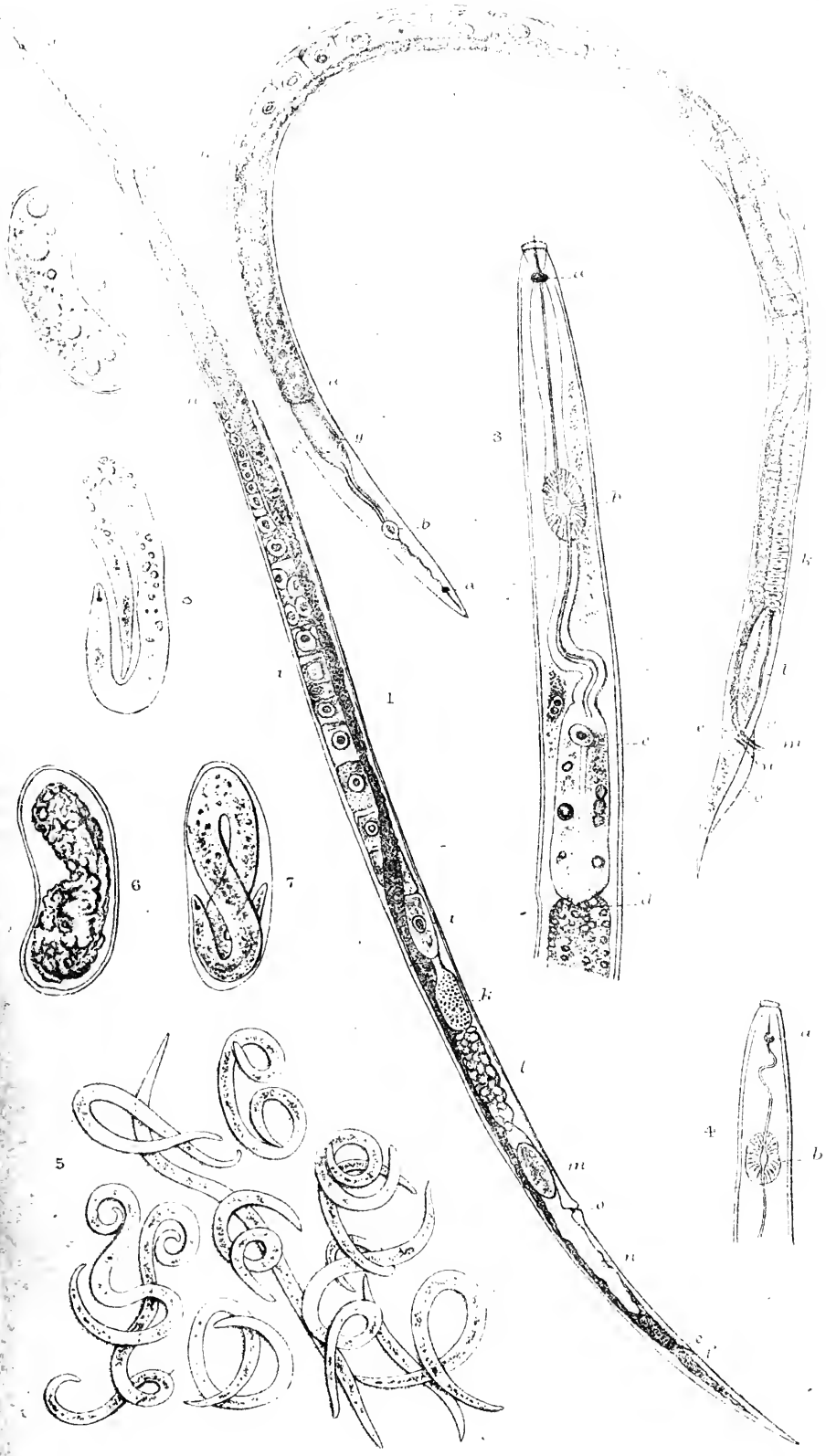

D^r J. Ritzema Bos ad nat. del

West Newman Lith.

Tylenchus devastatrix *Kuhn.*

REPORT OF OBSERVATIONS

OF

INJURIOUS INSECTS

AND

COMMON FARM PESTS,

DURING THE YEAR 1895,

WITH METHODS OF

PREVENTION AND REMEDY.

NINETEENTH REPORT.

BY

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PREFACE.

The observations of the past year have given us an unusually good opportunity of remarking how far amount of presence of injurious insects may be affected (or not affected at all) by exceptionally low temperatures, such as those from which we suffered in January and February of 1895. From records of extreme lowness of temperature taken from instruments in the regular Stevenson's screens,* we find the extraordinarily low minima that were registered at various stations from Aberdeen to Kent, thus ranging at distances from the North of Scotland to the South of England. These show readings *below zero* as follows: −17° at Braemar, Aberdeen; −13° Esthwaite, Lancashire; −8° Ketton, Rutland; −5° Loughborough; and −8° Bromley, Kent. That is to say, in the popular manner of expressing amount of cold, temperatures in order given above respectively of forty-nine, forty-five, forty, thirty-seven, and forty "degrees of frost"—*i.e.* degrees below freezing-point, which is 32° Fahrenheit.

At Loughborough the "mean" of the temperatures of the ten days from the 5th to the 14th of February inclusive was only 16·5°—that is, within a few fractions, sixteen "degrees of frost." These notes refer to the *air temperatures*, of which full records are given in our meteorological publications, and also with additions of local circumstances exceedingly serviceable for comparison with subsequent local insect conditions, and in the 'Times' daily meteorological reports published during the continuance of the unusual cold.

But beyond this, and in regard to the still more important point as to effects on insect life of the amount of cold *to which they are exposed in the ground wherein they lie*, I take leave to quote Mr. Symons's words: "Another striking proof of the severity of the 1895 frost is afforded by the temperature of the earth" ('Monthly Meteorological Magazine' for March, 1895).

* See Symons's 'Monthly Meteorological Magazine' for March, 1895. London: Edward Stanford.

For twelve consecutive days—that is, from February 12th to February 23rd inclusive—the thermometer with its bulb one foot below the surface of the earth (at Mr. Symons's own station at Camden Square, London, N.W.), at the 9 a.m. readings, only marked 31°, or 31° and one or more fractions, this showing (again to quote Mr. Symons) "twelve consecutive days, every one of which was cold beyond precedent since the observations" [at Camden Square] "began in 1871."

Of the widespread presence of low earth temperatures none will need to be reminded who (in towns) were inconvenienced by the deficiency of water supplies from breaking of the supply-pipes, or (in farm work) by the long-continued impossibility of getting the plough into the frost-bound ground. For record of this we have only to refer back to the weather notices in our leading agricultural journals; but, taking just two or three by way of examples, we find in the 'Dublin Farmer's Gazette' of March 2nd, 1895:—"The wintry weather that set in at the end of December continued with more or less severity to almost the end of February. There was a frost every night till that of the 27th—28th; but now . . . March has begun with a decided rise in the temperatures. The thaw seems also to be general in Great Britain; but the effects of the prolonged frost will be felt for some time to come." In the 'Agricultural Gazette' for March 4th (1895) the report of February 28th from Nottingham is as follows:—"To use the language of the day, the month of February, 1895, has been a 'record' in the shape of Arctic severity. To have the thermometer from two to ten degrees below zero five or six nights in succession is not within the memory, I suppose, of the oldest inhabitant." From West Herts (same date) it was noted:—"The frost is slowly going out of the ground. . . . Yesterday was the first day we have been able to plough since the long frost commenced."

For technical *meteorological* study, every detail will be found in the weather reports; but for the subject under consideration, the *agricultural* reports of the widespread impossibility of ploughing consequently on the frost-bound state of the ground give a better basis to stand on, as to action of cold on the insect presences frozen hard up in it, than anything else we could have.

So far as I can judge from reports sent to myself during 1895, I should certainly say that in no case was there evidence to show that presence of insect infestation was lessened by the severe

cold of the early part of the year. The *appearance* of *some* of the crop or fruit infestations was retarded until they were thawed into active life in their lurking-places, or the surface of the ground was sufficiently softened to allow them freedom; but beyond this I did not find any *direct* effect on insect presence from the cold. *Indirect* effect there certainly was, but this tending to *increase* the amount of insects, or of their injury, from various causes; as, for instance, sowing of spring corn being retarded, and the young plant consequently not having time to get ahead before the season of attack of its maggot pests; or, again, as in Forfarshire, where the severe weather and accompanying gales are even now bearing fruit in the quantities of Pine Beetles (*Hylurgus piniperda*) to which the broken and fallen Pine-boughs and timber afforded nurseries.

Looking at the insect attacks of last year in coincidence with the above-mentioned severe cold, we find that though there was not any widespread devastating attack of any one kind of insect all over the country, yet there were seriously injurious outbreaks of various kinds which winter in such methods as to expose them thoroughly to weather action, and thus show that cold cannot be looked to for protection.

The eggs of the Winter Moth (of which the caterpillars were one of the very bad attacks last year) are laid for the most part in the early winter on buds, twigs, &c., of orchard and other trees, where they are exposed to *all* weather, snow, thaw, frost, sunshine, and wind sweeping by to intensify the cold. The "Pine-shoot" Moth caterpillars (see p. 73) were obviously none the worse for their winter residence in their shelters at the end of the shoots. On *the surface* of the ground, the bad attack sent me at the beginning of April of the Cabbage Root-gall Weevil showed that these were uninjured by the then recently preceding cold. The unusually bad attacks of Gooseberry Sawfly caterpillar in the summer showed that the preceding generation had passed the winter very successfully in their cocoons *just below* the surface.

Crane Flies, or Daddy Longlegs grubs, may be found more or less from December onwards, and, weather permitting, sometimes are exceedingly mischievous at corn-roots in February; and the great damage to grass-roots at Langholm, Dumfries-shire (see p. 33), in the past season may be taken as a proof that these grubs are not cleared out by ground cold.

Almost all the common crop insect attacks were present, and amongst those deserving especial attention is that of the so-called "Ground Beetles" to Strawberries, which it was an especial pleasure to myself to work up thoroughly, both for practical use, and as showing the imprudence of attributing error to careful observers simply because it may chance the infestation is not known generally.

The great point, however, of the observations of last year has been the attacks of *Diptera* (two-winged flies) to cattle, horses, and other animals. These began with the Forest Fly enquiry set on foot early in the year, and extended thence to enquiries regarding other species of Hippoboscidæ, and thence to Gad and Breeze Flies, and also to Warble or Bot Flies, including amongst these the *Hypoderma lineata*, which represents our common Ox Bot Fly, the *H. bovis*, in the United States of America, and is present in this country, though whether injurious (in addition to our common kind) to any extent worth consideration, I have not yet had opportunity of ascertaining. Some information as to warble as an infestation of deer has also been kindly contributed, and, from the good supply of maggots sent, I have been enabled to identify the kind (as was to be expected) as the *Hypoderma diana*.

Altogether the year has been one of interesting observation regarding crop and animal insect pests, regarding which, space permitting, I should have been glad to give fuller details. The following list gives the names of most of the kinds of British insects of which I have had specimens or enquiries:—

Beetles (*Coleoptera*).

Bean-seed Weevil, *Bruchus rufimanus*	Stored Bean-seed.
Beet Carrion Beetle, *Silpha opaca*	Young Mangolds.
Cabbage Root-gall Weevil, *Ceutorhynchus sulcicollis*	Cabbage- & Turnip-roots.
Chafer, Cockchafer, *Melolontha vulgaris*	Leafage and Grass-roots.
,, Summer, *Rhizotrogus solstitialis*	,, ,,
,, Rose, *Phyllopertha horticola*	,, ,,
,, Golden, *Cetonia aurata*	Flowers.
Corn Beetle, *Cucujus testaceus*	Stored Corn.
Elm-bark Beetle, *Scolytus destructor*	Bark.
,, ,, *multistriatus*	,,
Granary Weevil, *Calandra* (*Sitophilus*) *granaria*	Stored Corn.
,, ,, ,, *oryzæ*	,,
Ground Beetle, *Pterostichus madidus*	Strawberry fruit.
,, ,, *vulgaris*	,,
,, *Harpalus ruficornis*	,,
Mangold Beetle (Pigmy), *Atomaria linearis*	Young Mangold-roots.
Mealworm Beetle, *Tenebrio molitor*	Meal and Flour.
Pea- and Bean-leaf Weevils, *Sitones* of different species	Leafage.
Pea-seed Weevil, *Bruchus pisi*	Stored Pea-seed.

Pine Beetle, *Hylurgus piniperda*	Pine-bark and shoots.
Plum Beetle, *Scolytus rugulosus*	Plum-branches.
"Timberman" Beetle, *Astynomus ædilis*	Pine-bark and wood.
Turnip-flower Beetle, *Meligethes æneus*	Blossoms and buds.
Turnip Mud-beetle, *Helophorus rugosus*	Turnip-bulbs and leafage.
Turnip-seed Weevil, *Ceutorhynchus assimilis*	Turnip-seed.
Weevil, Clay-coloured, *Otiorhynchus picipes*	Hop.
Wireworms (larvæ of various *Elaters*)	Roots of grass and crops.

Butterflies and Moths (*Lepidoptera*).

Antler Moth, *Charæas graminis*	Grass-roots.
Buff Tip Moth, *Pygæra bucephala*	Beech, &c.
Death's Head Moth, *Acherontia atropos*	Potato-leafage.
Eyed Hawk Moth, *Smerinthus ocellatus*	Apple-leafage.
Goat Moth, *Cossus ligniperda*	In trees.
Granary Moth, *Tinea granella*	Stored Grain.
Mediterranean Mill Moth, *Ephestia kuniella*	Wheat-flour.
Mottled Umber Moth, *Hybernia defoliaria*	Buds and leafage.
Pine-shoot Tortrix Moth, *Retinia defoliaria*	Pine-shoots.
Puss Moth, *Dicranura vinula*	Poplar-leaves.
"Red Bud" Caterpillar, *Lampronia rubiella*	Raspberry-stems and buds.
Turnip Moth, *Agrotis segetum*	Turnip and other roots.
Winter Moth, *Cheimatobia brumata*	Buds and leafage.

Two-winged Flies (*Diptera*).

Cabbage- and Turnip-root Maggots, *Anthomyia* of various species.	Roots.
Celery-leaf Miner, *Tephritis onopordinis*	Leaves.
Crane Fly or Daddy Longlegs, *Tipula oleracea*	Grass-roots.
,, Spotted, *Tipula maculosa*	,,
Forest Fly, *Hippobosca equina*	Horses. Cattle, &c.
Frit Fly, *Oscinis frit*	Oats.
Gad or Breeze Flies:—	
Great Gad Fly, *Tabanus bovinus*	Cattle and Horses.
Blinding Breeze Fly, *Chrysops cæcutiens*	,,
Horse Breeze Fly, *Hæmatopota pluvialis* *	,,
Gout Fly, *Chlorops tæniopus*	Barley.
Hessian Fly, *Cecidomyia destructor*	Wheat- and Barley-stems.
Mangold-leaf Maggot, *Anthomyia betæ*	Mangold-leaves.
Pear Gnat Midge, *Cecidomyia* (*Diplosis*) *pyrivora*	Young Pears.
Sheep "Tick" or Spider Fly, *Melophagus ovinus*	Sheeps' fleeces.
Warble Fly, *Hypoderma bovis*	Cattle hides.
Warble Fly (Deer), *Hypoderma diana*	Red Deer.

Sawflies, Gallflies, &c. (*Hymenoptera*).

Apple Sawfly, *Hoplocampa testudinea*	Young Apples.
Gooseberry Sawfly, *Nematus ribesii*	Gooseberry- and Currant-leaves.
Pine Sawfly, *Lophyrus pini*	Pine-leaves.
Oak Spangle Gall, *Neuroterus lenticularis*	Beneath leaves.
Oak Woolly Gall, *Andricus ramuli*	Woolly growth on male catkins.
Pear Slugworm, *Tenthredo cerasi*	Leafage.
Sirex, *Sirex gigas*	Fir timber.
,, Steel-blue, *Sirex juvencus*	,,

Aphides, Scale Insects, &c. (*Homoptera*).

American Blight Aphis, *Schizoneura lanigera*	Apple-bark.
Beech Aphis, *Phyllaphis fagi*	Beech-leaves.
Corn Aphis, *Aphis granaria*	Corn-ears.
"Colliers," *Aphis rumicis*	Mangold-leaves.
Woolly Currant Scale, *Pulvinaria ribesiæ*	Currant-stems.

* Other species of Gad Flies sent, enumerated at p. 123.

Besides the above there were various insect attacks of little agricultural interest, though affecting various trades or industries, and several only too important, as of Mites, or "Red Spider," namely, the Gooseberry Red Spiders, the *Bryobia prætiosa*, and also the *Bryobia ribis* (n. sp.), also the Black Currant Gall Mite, the *Phytoptus ribis*, which continues to spread, and the Hay Mite and Cheese Mite, respectively the *Tyroglyphus longior* and *T. siro*. Millepedes of various kinds, especially the Spotted Millepede, were, as usual, destructive; and altogether the year was marked by much presence of crop infestation; and also, as in previous years, there has been enquiry regarding colonial insect attack, especially to Sugar Canes.

I have to express my thanks for much kind assistance from colleagues, and for the many liberal presents of valuable entomological serials, by which I am greatly assisted in my work.

But amongst the entomological events of the past year, it is only a due respect to allude to the loss which all interested in the preservation of their crops or fruit have suffered in the decease of Dr. C. V. Riley, late Entomologist of the Department of Agriculture of the United States of America, consequently on being thrown from his bicycle. Dr. Riley was a countryman of our own, and, on his settlement in the United States of America, passed some years on a farm, thus laying a foundation of practical knowledge for the vast and sound scientific acquirement which claims for him the place of the greatest economic entomologist the world ever saw. For many years he has used his talents unceasingly in gaining, and also in freely imparting, information which has been of the utmost service in counteracting not only the great infestations of the Continent of America, but for which he was the special world-wide referee. In many points we benefited much by his assistance in this country; and to myself, as to all his friends, his death is the loss of a kind and skilled helper.

In home assistance in the past year, in addition to that which I have acknowledged accompanying the notes of the different infestations in regard to which I have met with much valuable aid, I desire to acknowledge very especially the cordial and courteous support always accorded both to my work and myself

by our agricultural, and also by much of our general Press. I thank them most heartily.

For the use of the illustrations at pp. 4, 15, 23, 26, 37, and 57, I am indebted to the courtesy of Messrs. Blackie & Son, Glasgow; figures at pp. 18 and 62 are from Newman's 'British Moths'; those of Breeze Flies at pp. 128, 130, by kind permission of Messrs. Baillière & Co., are from Neumann's 'Animal Parasites,' translated by Dr. Fleming; the remainder, excepting where otherwise mentioned, have been prepared for this series of Reports, and are mainly from the pencil of Mr. Horace Knight, of the staff of Messrs. West, Newman & Co., 54, Hatton Garden; and amongst these I think the two plates giving figures of the complicated structure of the foot of the Forest Fly will be found of much interest.

In the coming season I hope to continue attention to all enquiries regarding insect infestations with which I may be favoured, to the very best of my power; and, further, I should like to add that, amongst work in progress, I trust that the Exhibit of Economic Entomology which, by the courteous request of the Council of the Bath and West and Southern Counties Society, I am preparing for their meeting at St. Albans in May next (accompanied by a series of coloured diagrams, from the pencil of my sister, of subjects specially selected) may be found practically useful.

ELEANOR A. ORMEROD, F.E.S.

Torrington House, St. Albans,

February, 1896.

List of Attacks of Injurious Insects, &c., noticed in this Report.

Flies Injurious to Horses, Cattle, &c.

Ticks.

* These two species were sent from Indian localities, but are noted, as being similar to our own kind in habits and remedial measures.

NOTES OF OBSERVATIONS

OF

INJURIOUS INSECTS

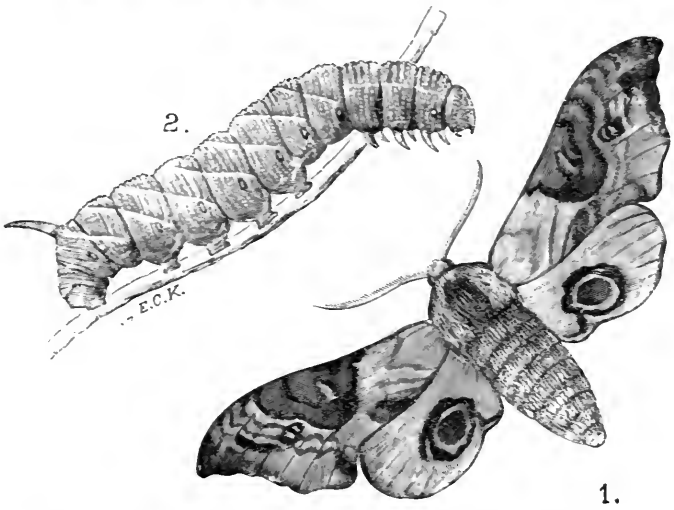
AND

COMMON CROP PESTS

DURING 1895.

APPLE.

Eyed Hawk Moth. *Smerinthus ocellatus*, L.



SMERINTHUS OCELLATUS.—1, Eyed Hawk Moth; 2, caterpillar.

THE great green caterpillars of the Eyed Hawk Moth, which I noticed in my preceding Report, appear to call for a few additional observations as being more of an orchard pest than has been generally supposed. In 1894 I heard of them from Bewdley, in Worcestershire, and from Meldreth, Cambridgeshire; and in the past season they have been mentioned as to some degree troublesome from two localities in

Kent. The observations previously given appear to have directed attention to the great mischief which the caterpillars *can* cause when present, but of which the reason is often overlooked, notwithstanding their great size, from their colour so much resembling that of the Apple-leaves.

The damage, it will be seen on reference, is generally noticed as being to the young trees, and also (where it occurs at all) as completely sweeping off the attacked leafage. In one of the 1894 notices it is mentioned :—"The caterpillar is very destructive; from its colour it is scarcely discernible, and attention is only drawn to it by seeing the young shoot, which it seems to prefer, entirely stripped of its leaves." —(T. H.) Another observation of the same date noted regarding the caterpillars :—"I have found seven or eight each on a separate tree (Apple-trees planted one or two years). They entirely denude the tree of all its leaves."—(A. H.) *

On the 25th of Feb., 1895, Mr. Sydney Lee wrote me from Crocken Hill, Swanley Junction, Kent :—"*Re* the Eyed Hawk Moth.—They are not very common in this district, as when I showed a number to some fruit-growers here, they looked on them more as curiosities. I have found quite a number during the last two seasons,—should think I found almost fifty during the last. I found them only on young Apple-trees. Although so large, we do not look on them as particularly troublesome because of their comparative scarcity."

On the 28th of August I received a good specimen of the caterpillar from Mr. Charles Ramsey, of the Fruit Nurseries, Crawley, Kent, with enquiries as to its name and history, and mention that it was "not a very troublesome pest at present, being only found on Apple-trees here and there about the nursery"; but that it eats all the leaves of the young trees, then drops to the ground, and burrows out of sight.

The caterpillar, when full-grown, is about the size figured, but it has been recorded as quite three inches in length; the colour of a yellowish or bluish-green, or of the colour known as "apple-green"; the skin rough, and dotted with white, and having on each side seven white stripes slanting backwards at the top; the seventh stripe longer than the others, and continued up the horn-like process at the tail. This horn varies in colour: early in life it is pink; when the grub is nearly full-grown it is pale or sky-blue in colour, and greenish or black at the tip, and the side stripes, at least when the grub is nearly full-grown, have a line of darkish green along the front edge. The head (after the first moult) is triangular at the top; the claw-feet pinkish-brown, the sucker-feet green. The grub varies very much in colouring during its growth. †

* See page 2 of 'Eighteenth Report on Injurious Insects,' by Ed.

† For full details see 'Larvæ of British Butterflies and Moths' (Ray Society), by Wm. Buckler, vol. ii. pp. 99—103.

When full-fed (as noted above by Mr. Ramsey) the caterpillar goes down into the ground. There it turns, in a little chamber about two inches below the surface, to a red-brown chrysalis, from which the moth comes out in the following summer. Thus, to quote the summary of life-history given by the Rev. John Hellins in page 100 of work cited before, "we have the moth in May, June, and July; the larva stage lasting some six weeks in June, July, August, or September; and the pupa stage extending through autumn, winter, and spring." The earliest day of egg-laying which I find noticed is June 11th.

The moth is a beautiful insect, of the shape and markings figured at page 1, but not usually quite so large. The fore wings are rosy-brown or ash colour, with olive-brown markings; the hinder wings rosy, shading to brown or grey at the margin, with the large eye-like spot, from which the name of "Eyed" Hawk Moth is given, in the centre of each wing. These spots are grey in the centre, with a blue ring outside, and this again surrounded by a black border.

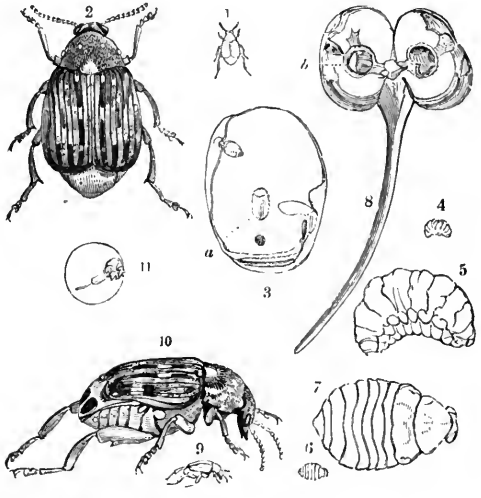
In regard to methods of prevention and remedy, one good plan, where the caterpillars have been observed on the Apple-trees, would be to skim off the surface soil, taking care not to go deep enough to hurt such Apple-roots as may be near the surface. The large red-brown chrysalids would be easily seen, and might be destroyed, or any boys about the garden might be allowed to earn a few pence by selling them (as they are not very commonly met with) to any neighbouring "naturalist."

Generally the infestation does not seem to be noticed (at least practically) until it fairly forces itself on attention by the leafage of the attacked boughs being stripped; but where the caterpillars are known to have been present in the previous season it would be well to keep watch, and clear them before they are getting to their full growth towards the latter part of August or beginning of September. By jarring the boughs so as to make the caterpillars fall, or by hand-picking from the young trees which appear to be the most attacked, this might easily be done.

It is objected to me by some of our entomologists that it is a pity to destroy these handsome and somewhat scarce insects, but it appears to me that where we have the opportunity, it is much the most desirable way with great insects that have an obvious power of wasting our crops to get rid of them as completely as we can.

BEAN.

The **European Bruchus** or **Bean-seed Beetle.** *Bruchus rufimanus*, Boheman and Schön.; = *B. granarius*, Curtis. **American** and **South African Bean-seed Beetle.** *Bruchus fabæ*, Riley; = *B. obsoletus*, Say, also *B. obtectus*, Say.



1 and 2, *Bruchus rufimanus*, nat. size and mag.; 3, infested Bean split open; 4 and 5, larvæ, nat. size and mag.; 6 and 7, pupæ, nat. size and mag.; 8, Bean injured by beetle, vegetating; 9 and 10, *B. pisi* (Pea-seed Beetle), nat. size and mag.; 11, injured Pea.

The attack of the Broad Bean-seed Weevil, scientifically distinguishable as the *Bruchus rufimanus* (sometimes, formerly, as the *B. granarius*), is always more or less present here, and has been one of our regular pests, as shown by the late Prof. Westwood, for some time before the year 1839; but as in some observations published in September last the compiler was obviously not aware of the distinctions between this our common English kind and the still more injurious kind *Bruchus fabæ*, which has of late years been under notice of the Board of Agriculture of the United States of America, it may save the repetition of somewhat grave error, and save also unnecessary anxiety, to offer some observations on both species.

So far as may be learnt from reports, or our standard catalogues of British beetles, or standard entomological works, I believe the *Bruchus fabæ* has *never* yet been known here; but it may come, and as I have had the opportunity of minute study of the insect, and its extraordinary power of doing injury, in specimens sent me from our own colonists in

South Africa (where, as well as in the United States, it is to be found), I add to the following observations on our own special Bean-seed pest some notes regarding the more destructive kind brought up to date of writing these lines.

"*Bruchus rufimanus* is the common Bean Weevil of England. . . . It is both a common and destructive insect." * The species is considered to range throughout central and southern Europe, Syria, Egypt, and all of northern Africa, and also occurs at Monte Video, South America. The above-named wide distribution accounts for the great extent to which it occurs in imported Broad Beans, a subject on which especial enquiries were sent me during the past season.

The beetles are rather less than the sixth of an inch in length, and of the shape figured at 1 and 2 (nat. size and magnified); the ground colour black, but with some degree of clothing of short brown hairs. The thorax (or fore body) has a white spot at each of the hinder angles, and a triangular spot between them. The wing-cases have a brown stripe down the suture, and outside this four white spots on the disc placed on a deep black longitudinal line (see figure); they are also sprinkled with small dots of white hair. The apical segments of the abdomen (which is not covered by the wing-cases) is grey. The antennæ dark, with the four joints nearest the head rusty colour; and the fore pair of legs is also rusty,—whence the name of *rufimanus*, or red-handed. The wings are ample. When the beetles are fresh, the markings show clearly, but very often they have been so much rubbed that the brown and white "pattern," so to call it, is removed, and little but the black ground of the wing-cases is to be seen.

The method of attack is for the beetle to fly to the blossoming Beans, and to lay its eggs on the young seed-vessel in the centre of the Bean-flower whilst it is still quite in embryo state (not large enough to be called a pod). From these eggs the grubs soon hatch, and make their way into the growing Beans. These grubs (or larvæ) are fleshy, wrinkled across, thick in shape, and have a small, horny, rusty-coloured head, and (so far as has been recorded) they are footless. Each maggot gnaws a round gallery into the growing Bean; sometimes there may be only one tunnel, sometimes several; and in its tunnel, amongst the dust and dirt consequent on its gnawings, the grub turns to the chrysalis, and thence to the beetle condition. But before it changes to the chrysalis state, it gnaws its gallery right up to the skin of the Bean, not through it; so that this circular bit of skin remains as a little round cap at the end of the burrow, just sinking in a little from the substance of the Bean having been hollowed out behind it, and when the time for the beetle to leave the Bean has arrived, it has

* 'Seventh Report of Injurious and other Insects of the State of New York, U.S.A.,' by Dr. J. A. Lintner, State Entomologist, Albany, N. Y., 1891, p. 280.

only to press out what may be called the door of its tunnel, and effect its exit.

Thus the fact of whether there is, or has been, presence of weevil-attack in the Broad Bean-seed may almost certainly be known. If there are one or more small round depressions where the skin of the Bean-seed is partly transparent, or again, if instead of the little depressions the round bit of skin has fallen off, and there are one or more little round holes like shot-holes right into the Bean, then it may be taken as a certainty that the Bean either is then, or has been, infested with the weevil.

In 1888 there was an unusual prevalence of this attack at localities in Kent, Essex, and Buckinghamshire, and also to some degree in Hertfordshire, and the observations then sent me,* being in several instances from leading agriculturists, gave much useful information on effects and means of prevention of the infestation which had not previously been brought forward.

Since then some advance has been made on various points, both as to structure, and amount of injury caused by attack of Bean and Pea Weevils, but still nothing like the attention is given to the subject which it deserves, and the following note, which I give (with thanks) from the number of the 'Scottish Farmer' for May 4th, shows the inconveniences that may occur from want of knowledge of the outward signs of grub or beetle-presence in the Bean.

The enquiry sent was as follows:—"A quantity of Beans were sent to a laundry for consumption by horses, and at the time of delivery they appeared to be perfectly free from any kind of pest. In a short time they were returned very badly infested by such insects as are sent herewith. Can you explain how this took place?"—(Q. C.)

To this I replied:—"Both of the parties in this Bean-seed case are in a sense right. The Beans would very probably show no external signs of the infestation within, excepting to those who knew what these signs were; and yet the beetles were within, being just on the very point of coming out. The Beans that appeared quite clean when sent off, would promptly be even swarming with the beetles."

If seller and buyer had been aware of the presence of the beetle-infestation within being shown by the little depressed bit of skin (as noted above) over the insect-tunnel, the whole perplexity and inconvenience would have been avoided.

Weevil-infestation is by no means confined to home-grown seed, and requests for information on this subject come in the common course. In the past season I received a communication from Mr. Wallace, of Eardiston, Tenbury, Worcestershire, with specimens of Bean-seed Weevil accompanying, and mention that they were "speci-

* See my 'Eleventh Annual Report.'

mens of a beetle which is now emerging from some foreign Beans he had lately bought"; also a request for information as to what they were, and whether they were in any way likely to be injurious, so that, if necessary, steps might be taken to destroy them.

In this case, as the Beans had been purchased for feeding purposes, Mr. Wallace, on hearing about the nature of the infestation, had them ground at once.*

On May 30th enquiry was also sent me as to *Bruchus*-infestation in imported Beans by Prof. John Golding, Lecturer on Chemistry at University College, Nottingham; these, he mentioned, were Italian-grown Seville Long-pod Beans, and he desired to know the name of the beetle, and whether it had been known to live in England, and infest the seed of an English-grown crop of Beans in the same way that the Pea and Bean Weevil does.

In the above and other cases of home or imported infestation of Beans by *Bruchi* sent me for examination, I have never seen any reason to suppose that the injuries were caused by the *B. fabæ*, but either certainly or presumably by the *B. rufimanus;* and in the notes immediately following I give some detailed observations on the *Bruchus fabæ* which might to some degree be described as the U. S. A. and S. African Bean-seed Weevil.

The *Bruchus fabæ*, Riley, the Bean-seed Beetle (at one time known as the *Bruchus obsoletus*, Say, and now as the *Bruchus obtectus*, Say),† was first recognized and described by Thomas Say from American specimens somewhere about the year 1832, and was for a long time considered to be a U.S.A. species; but it was not until the year 1860 that it was recorded (by Dr. Fitch) as infesting cultivated Beans, and the attack rapidly spread, mainly, it is believed, by means of infested Beans.

The following is the technical description by Say:—"Body blackish-cinereous, with a slight tinge of brown; antennæ not deeply serrate; thorax much narrowed before, cinereous each side, a slight impressed dorsal line; base with the edge almost angulated, central

* If it was merely a consideration of getting rid of the maggots or chrysalids, the grinding might be expected to be successful; but with the fully developed beetles it may not always be so, at least in former methods of grinding it was not; for John Curtis gives an instance of a cargo of 1000 quarters of large Beans imported from Sicily to Newcastle-on-Tyne in September, 1850, being so infested that the meal after passing through the millstones was apparently alive with the beetles, which took wing and flew about the mill in thousands.—'Farm Insects,' by John Curtis, note, p. 363.

† See 'Insect Life,' vol. vii., No. 5, p. 419; edited, by L. O. Howard, Entomologist of the U. S. A. Board of Agriculture, Washington, 1895; received whilst these notes were in preparation.

lobe almost truncate; scutel quadrate lightish, longitudinally divided by a dusky line; elytra with the interstitial lines having a slight appearance of alternating whitish and dusky; on the middle of the third interstitial line is a more abbreviated whitish line; posterior thighs with a black spine and two smaller ones. Length over one-tenth of an inch. The whitish or cinereous markings are not very striking; on the elytra they may sometimes be traced into two obsolete macular bands."

This beetle in general appearance is very like the Bean and Pea Weevils figured at p. 4, but is rather smaller, only about one-tenth of an inch long, and is generally described as of a tawny-grey, with more or less dull yellowish, and the main point of difference is the lesser quantity of the white markings. But there are some very remarkable points in the life-history, which I quote from the paper on Pea and Bean Weevils by Prof. Riley (late) and Mr. L. O. Howard (present), Entomologists to the U. S. A. Board of Agriculture.*

One point is the great number (as many as twenty-eight) of the individuals which may be found feeding at once in one Bean (a much worse state of things than we have present here). "A second point of difference, and one of great economic importance, is that the insects will continue breeding indefinitely in stored Beans." The eggs are primarily laid on the Bean-pod as with our kind, and, as with us, some of the beetles may come out in the following autumn, some in the spring. "If easy means of exit are not present, the females will soon begin to lay their eggs upon the stored and damaged Beans, and another generation will soon develop. This may go on indefinitely, or until the food supply is exhausted. The Bean Weevil continues to multiply in the stored Beans. These, when infested, are usually reduced at last to nothing but powder, and have no value as seed." †

Another very great peculiarity is the possession of three pairs of slender legs by the larva of this species (the *Bruchus fabæ*, Riley, now named the *B. obtectus*, Say) in its first stage. Thus, with the help of some other structural peculiarities, it can travel about among the Beans, and make its way within where it finds a spot on the seed suited for its entrance (*vide* paper quoted below).

For full information regarding this attack, with figures, &c., the reader is referred to the number of 'Insect Life' cited, also the exhaustive paper by Dr. Lintner (of which the title is given below ‡), together with the works and previous U. S. A. publications therein quoted; but having myself had the opportunity of observation of this species in

* See 'Insect Life,' vol. iv., Nos. 9 and 10, pp. 299—302.

† *Loc. cit.*, pp. 299—300.

‡ 'Seventh Report of the Injurious and other Insects of the State of New York,' by J. A Lintner, Ph.D., State Entomologist, pp. 255—288.

connection with the great injury caused by it to Bean-seed in South Africa, I append some extracts from my paper on it given in my 'Notes on some Injurious Insects of South Africa.' *

My observations were taken from specimens forwarded to me from Port Elizabeth, South Africa, including the weevil in all its stages, together with injured Beans, which, in some instances, contained the beetle fully or partially developed.

At the time, we were not able to identify the species of *Bruchus* with certainty, and therefore merely noted it as much resembling the *B. subarmatus*, Gyll. Subsequently, in the course of much correspondence on identification of Bean-seed Beetles between Dr. J. A. Lintner, Mr. Janson, and myself, it appeared, from type specimens submitted for comparison with our South African kind to Mr. Janson, that these were, without doubt, the *B. obsoletus*, Say, known also as the *B. fabæ*, Riley, and now, after much consideration of which of its various synonyms should be accepted as the authorized name, distinguished as the *B. obtectus*, Say.†

The localities of the species are Central and South America, Madeira, Canaries, Azores, Mediterranean basin, Persia, &c. Carried by commerce it is probably cosmopolite.

The full description by Mr. Janson is given at length in my South African notes, but the following note is sufficient here:—"Compared with our well-known Bean-seed Beetle (*B. rufimanus*, Boh.), it is smaller, rather more depressed above, has a narrower thorax, without teeth at the sides, and has the posterior femora furnished with a small acute tooth near the apex; the colour of the middle and hind legs and markings on the elytra are also different." For these see description at pp. 7–8, which, as we do not need two of the same beetle, I have selected for insertion rather than that in my own publication.

In regard to the amount and method of the infestation of the South African Bean-seed Beetles, I found in two of the Beans four holes where beetles had escaped, in another seven beetles had been present, and in another five beetles, or coloured chrysalids, were still within. But it was mentioned by Mr. S. D. Bairstow, of Port Elizabeth, from whom I received them, that "this pest when in larval condition reduces the interior of the seed to a fine powder"; and the ruinous nature of the infestation was thoroughly proved by the condition of the Beans sent, which ranged from presence of four, five, or seven beetle-perforations up to the Bean being completely crumbled to pieces.

* 'Notes and Descriptions of a few Injurious Farm and Fruit Insects of South Africa,' compiled by Eleanor A. Ormerod, Consulting Entomologist of the Royal Agricultural Society of England; with descriptions and identifications of the insects by Oliver E. Janson, F.E.S. 1889.

† See 'Insect Life,' vol. vii., No. 5, p. 419. Washington, 1895.

On examination of the infested Beans, I noticed a difference in the method of maggot-attack (see pp. 25, 26 of 'South African Insects') from that of our *B. rufimanus*. Instead of the maggot-tunnels ending as soon as they came to the outside of the Bean, I found that they sometimes ran on just under the skin, so that their shape and the blackish colour of the insects when developed to the beetle state could be distinctly seen through the thin transparent coats of the Bean. Also, in some instances, it appeared from the gnawings that the maggot had made, or might have made, its entrance into the seed from the outside.

On microscopic examination, I found the larva of this South African Bean-seed Weevil (the *B. fabæ*, Riley, = *B. obtectus*, Say) to be not only, as is commonly the case with maggots of the *Bruchi*, much corrugated, but also that the three segments next the head were distinctly divided from each other, and that each of these segments was furnished with a pair of appendages placed in the common position of feet, and, as far as I could see, answering the purpose of the three pairs of claw-feet which are found in many beetle grubs. The appendages appeared to me to be one-jointed, and slightly conical or curved.* The specimens, being dried, were not in a wholly satisfactory state for examination; but in connection with the foot structure, of which the observations by Prof. Riley are given at p. 8, it would be of much interest to have further observations, which the recent appointment of a skilled Government entomologist in Cape Colony has now rendered conveniently practicable.

Injury from infestation to germination.—The amount of this is much the greatest in the case of the American and African Bean-seed Beetle. Where the whole contents of the Bean are destroyed, the mischief done is beyond question. But this weevil, having in ordinary course the habit of not only destroying much of the future seed-leaves, but of at times totally destroying the germ, is an especially injurious Bean pest. The following extract from detail of experiment at Kansas State Experiment Station on weevilled Beans gives useful information on this point:—

"Fifty per cent. started; of these three-fifths might have grown into plants, as the injury was restricted to the seed-leaves. But the remaining two-fifths were variously mutilated by the loss of a part or the whole of the germ or plumule, so that under no circumstances could they have made plants. Here then but thirty per cent. could have passed the germinating stage, and these, owing to more or less considerable injury to the seed-leaves, would probably have made plants of low vigour. In a check lot of perfect Beans of the same

* See 'Injurious Insects of South Africa,' by Ed. (previously cited), pp. 25, 26.

varieties, and in the same numbers, planted alongside, ninety-five per cent. germinated." *

From experiments made by the same observers, also at the Kansas Station, the great loss on weevilled Peas by deficient germination is fully proved, and is followed by the remarks of the joint writers of the paper—Prof. Riley, late Entomologist of the U.S.A. Board of Agriculture, and Mr. L. O. Howard, his successor:—"This evidence practically settles the long-mooted question, and it is safe to say definitely that weevilled or 'buggy' Peas should not be planted." Also, "The remark which we have just made regarding the germination of weevilled Peas will apply equally well to Beans damaged by *Bruchus*."

The amount of injury to one or other of the two kinds of seeds of course depends partly on the amount of what would have been the seed-leaves which is eaten away, and the consequent amount of removal of what would have fed the young plant in its first growth, and also, and very materially, whether it is the nature of the pest to feed on the germ in the seed. This makes an enormous difference in the practical importance of the two Bean-seed attacks under consideration.

It is proved that *fabæ* (=*obtectus*) will feed on the germ, but there does not appear to be proof that such is the habit of our own special long-known pest the *rufimanus;* but the experiments of Mr. Theodore Wood show with regard to this kind that risks arise from the use of even slightly injured seed.

From a number of infested seeds of *B. rufimanus*, Mr. Wood selected twenty; three of which had been perforated by three weevils, five by two, and twelve by *one only*. They were sown under favourable circumstances, and grew thoroughly well; but when the time for fruiting came the blossoms were few and small, the foliage faded, and several of the plants died without producing a pod. In Mr. Wood's own words:—

"Of the first three plants raised from seed pierced by *three* weevils, one was altogether barren, while the remaining two bore but three pods between them, none of which arrived at perfection. The next five, grown from seed tenanted by *two* beetles only, were slightly more fruitful, bearing in all six pods, of which five reached their full growth; two of these five plants, however, were barren. Upon the remaining twelve, the seed of which had but one perforation, I counted twenty-three pods, not more than ten of which arrived at maturity. Only one plant of the latter was entirely unfruitful. It will thus be seen that the twenty plants bore among them but thirty-two pods, in all of which less than one-half came to perfection."—'Entomologist's Monthly Magazine,' xxii. p. 114; 1885.

* See experiments by Prof. E. A. Popenoe, of Kansas Experiment Station, quoted in 'Insect Life,' Nos. 9 and 10, vol. iv. p. 302. U.S.A. Department of Agriculture. 1892.

Mr. Wood notes that the kind of Bean he experimented on was not one of the most freely bearing kinds, six pods to a plant being the average yield; but if we look at the fact that, instead of 120 pods, which at an average yield was to be expected, only thirty-two pods were formed, of which fourteen pods did not reach full growth, and also that three plants were barren, the result points very strongly (as pointed out by Mr. Wood) to the presence of the infestation being highly prejudicial not to the germinating qualities of the seed, which appeared to be uninjured, "but to the reproductive capabilities of the adult plant."

I certainly think,—from the enquiries sent to myself as to the cause of deficient growth of Bean-plants when some way advanced to maturity, and when no reason can be found in state of ground or of weather, or from presence of any kind of insect or eelworm infestation on or in the plants,—that it would be very desirable for this point of bad effect of injured seed on crop development to be made the subject of field observation.

In regard to direct loss of weight, and consequently of money return, in the case of *Bruchus*-infested Beans, the following notes were sent me in 1888 by Mr. E. A. Fitch, of Maldon, Essex, who was (and is) well acquainted with the subject, both as an agriculturist on a large scale, and as an entomologist. Mr. Fitch reported with regard to damage by Bean-seed Weevil, *B. rufimanus*:—"In my own case a most moderate computation of loss of weight alone of 2*s*. per quarter, would give £65 12*s*., *i. e.*, 164 acres × 4 quarters the acre × 2*s*. per quarter."

To this Mr. Fitch added the following note:—"The much-talked-and-written-of Hessian Fly has not been nearly as destructive in Essex last year (1887) as this small beetle. The complaint of holey or bug-eaten Beans comes from all over the country, and is by no means confined to the Bean-growing lands; where Beans have been grown on our light land, they have suffered equally with those usually grown on the heavy land. I have myself delivered Winter Beans in other years weighing 19 stone 4 lbs. (67½ lbs. per bushel); and I hear from the corn merchants that nothing over 18 stone can be expected this year; a year in which condition, and consequently weight, is exceptionally heavy, the loss being entirely due to the ravages of the *Bruchus*."—(E. A. F.)

Without going into details as to the Beans being unsaleable (which does occur) from maggot-injury, the above gives some definite account of what damage may be.

Prevention and Remedies.—The first of these,—and a method which (if buyers could but be persuaded to adopt it) would save loss from deficient growth of crop to begin with, besides subsequent loss

from recurrence of beetle-attack to the seed,—is *thorough examination* of the Broad or Tick Bean-seed before purchase. If the seed has been infested (which is shown by the holes), the farmer sows a damaged article which will not yield him a full return; if he sows Beans with a few little pits of transparent skin about as big as would cover a common shot-hole, he at the same time (unless he has had the trouble and expense of killing the pest in the seed) *sows a coming crop of Bean-seed Beetles!* If the buyer has a doubt as to the state of the seeds, just splitting some open with his knife will show him exactly what their state is. Autumn-sown Beans are much more likely to contain infestation than the spring-sown, as many of the beetles will still be within.

There is often a little black spot on Beans which have been attacked, caused apparently by the original passage of the maggot into the young seed. This spot, when seen under a magnifier, looks much as if a small hot needle had been driven into the Bean, and the edge of the little round hole, and just a little way round it, had been burnt black. On opening the seed just below the black spot, I have usually found the commencement of a larval gallery, or a little chamber, as if the young maggot had fed there for a while before travelling onwards. But the spot is so indistinguishable without a magnifier, that practically it is little use in showing infestation.

A safe and easily practicable method of dressing infested Beans so as to kill the contained infestation is that (recommended by Mr. Geo. Street, of Maulden, Ampthill, in 1888) of application of blue vitriol and McDougall's Sewage Carbolic. On May 10th in that year Mr. Street wrote me (with regard to whether the Beans would be injured thereby) that they had made wonderful progress, and the result, so far as he could see, was perfectly satisfactory. "The dressing applied to the Beans was used in a similar way to that used for seed-wheat. Formerly we used blue vitriol only, but the addition of McDougall's Sewage Carbolic leaves a smell, which to some extent prevents birds eating the seed-corn. I am inclined to think the carbolic alone would be sufficient, if a larger quantity was used. We used 6 bushels of Beans, 6 quarts of water, 1 lb. of blue vitriol, and a pint of Sewage Carbolic. I am inclined to think that Beans should be dressed some few days before they are sown (as the skin is thick), and turned over with a shovel every day. Those which escaped the liquid dressing might be killed by the strong dust which would be formed when the Beans were again dry."

Another correspondent in the same year mentioned that he had "dressed all the seed with Calvert's Sewage Carbolic Acid, of such strength as to kill all the insects in the Beans without damaging the seed."—(See 'Twelfth Report on Injurious Insects,' by Ed., p. 23.)

In my own experiments (quoted in same Report) I found that, if the Bean-seed was placed for a short time to soak, the water passed through the thin film of skin of the Bean into the grub-tunnel, and so soddened the powdery dust and dirt in which the beetle was lying within, that the insect could not free itself, and was killed. If this was found to answer on a working scale, it would save the expense of chemicals; but there might be damage to the Beans if from any circumstances they could not be sown soon after being wetted.

Keeping Bean-seed shut up until all the weevils have come out and died is a method which may be used with our Bean Weevil-attack; but is no use against what may be called the U. S. A. kind, in which in captivity the successive generations lay eggs, and the maggots feed in the Beans till the seed is destroyed.

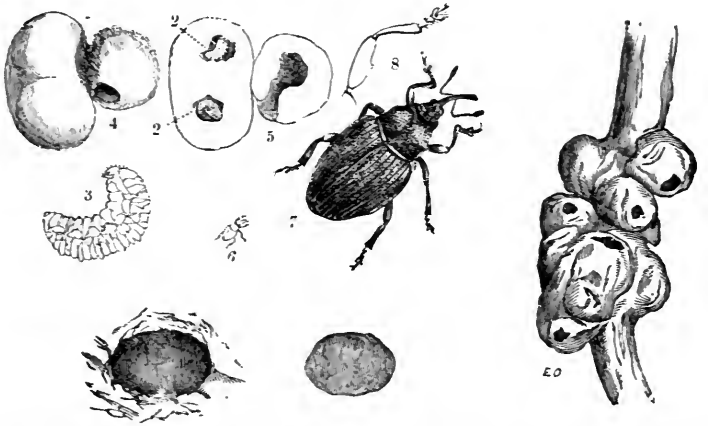
Bisulphide of carbon.—The vapour of this is stated (p. 276 of Dr. Lintner's Report previously cited) to be an infallible means of killing Bean and Pea Weevil. "The infested Beans may be put in some tight vessel, box or bin, with a cup containing bisulphide of carbon upon them, covering up closely, and leaving for a day or two." The heavy vapour is stated to kill all animal life present, without injury to the germ or impairment of utility of the Beans as food; only, as the *vapour is inflammable*, precautions must be taken not to bring a light near it. The plan has been much used on a large scale by filling a building with sacks of Peas, making it air-tight, and then, by means of a special apparatus, driving in bisulphide of carbon. This was used by Pea-growers in northern New York State in a time of great emergency to check increase of Pea Weevil, and will be found noticed as referred to below.*

In the above observations I hope it will not be thought I have gone into the subject at unreasonable length, as it is in the view of meeting a constantly recurring trouble which might be greatly lessened; and also entering on the still worse Bean pest which, though there does *not* appear to be the slightest reason to suppose we ever have had it in this country, certainly is in one at least of our colonies a serious crop evil, and may by possibility some time be imported here.

* Bulletin 58. Michigan Agricultural Experiment Station, State Agricultural College Association, 1890. 'Insecticides' (Bisulphide of Carbon), pp. 8—12.

CABBAGE.

Cabbage and Turnip Root-gall Weevil. *Ceuthorhynchus sulcicollis*, Gyll.



CEUTHORHYNCHUS SULCICOLLIS.—1–5, gall and maggots, nat. size and mag.; 6 and 7, weevil, nat. size and mag.; 8, leg of weevil, mag. Also cocoon, and cocoon in earth-cell, and Cabbage-root with galls, drawn from life by ED.

The small knob-like excrescences on Cabbage-roots (and also on Turnip-bulbs), which are caused by the presence of the grub of a small weevil-beetle, are a most common malformation, and though the plants would be better without them, still they are not generally considered to do very much mischief. Last spring, however, the first observations of their appearance (which were sent at the beginning of April) were of some especial interest, as showing that the grubs were in no way injured by the long-continued and very unusually severe cold of the preceding winter, which could only be said to begin to break up generally towards the end of February; and also the specimens sent showed in one instance, and on the broad scale of field cultivation (as they were samples of an intended purchase of 4000 plants), an amount of serious injury from the severity of gall infestation which I have never met with before.

On the 4th of April Mr. Steabbens, of St. Albans, sent me samples of a large number of Cabbage-plants submitted to him for purchase, all of which I found to be infested with weevil-galls. In a few instances the mischief was done, the gall was open, and the outside partly broken off and gone, as well as the maggot, but for the most part the grubs were still present. Some of the plants sent showed only a few of the lumps or galls, averaging about half an inch across; but

sometimes they had larger lumps of galls grown together, so as to make compound globular swellings up to about half an inch by one inch in diameter, often with passages gnawed by the maggots from one confluent gall to the other, so that the inside was a brown, discoloured, roughly eaten-out chamber, more or less advanced towards decay. This rough chamber might be found encircling very nearly the whole of the Cabbage-stem a little below ground-level, and many of the plants were so much smaller for a short length above the galls as to appear as if the growth had been appreciably stunted by the gall-presence.

The maggots were of various ages, and in some few instances had not yet cleared away much of the inside of the smaller galls, which were still only a little decayed and discoloured within.

In one instance where there was a large mass of confluent galls, about four or five grown together, I found the eaten-away hollowed chamber extending nearly round the stem, without any maggots present excepting at one extremity, where a fairly sound gall remained with only a hole for passage eaten into it; and in this gall I found four maggots, apparently the previous tenants of these other galls.

The Cabbage-plants averaged about eight to ten inches in length, and their advanced size, and also the size of the galls, made remedial measures difficult, if not impossible. The maggot gnawings went down to (or well into) the surface of the root, so as entirely to destroy the outer part, in some cases to a depth ruinous to the plant, unless subsequent circumstances might cause a good development of roots above the injured part. If the galls had been cut or scraped away, this, at the size to which they were grown, would have made such large wounds that it would have been very far from certain that they would heal; and if not cut off they made a centre for spread of decay from the gnawed tissue and the maggot-dirt in the galls.

The samples were a portion of two hundred score of plants, and on enquiry the sender told me that of these some were more, some less, infested than the specimens put in my hands; but that all except about one in nineteen or twenty were galled. This was the very worst instance of Cabbage-root gall attack that I have ever seen, and I strongly advised return of the plants, which were considered to be practically useless, and such return was intended to be made.

Other communication sent gave nothing new; only showed that the weevil grubs were in good health, and some of them remarkably well-grown specimens at the beginning of April.

If this attack was usually seriously hurtful it would be worth while to draw attention to the absolute certainty of perpetuating it by growing Cabbage year after year on the same ground; but as the case stands perhaps it does not very much matter.

It is an infestation, however, which is remarkably little liable to be checked by natural causes. The hard blackish weevil beetles, only about the eighth of an inch in length, of the shape figured magnified at 7, p. 15, are hardly observable as a matter of field infestation. The maggots produced from the eggs laid by the female beetles are at first hardly perceptible in the galls which their presence causes. They lie there as thick-made whitish or yellowish and legless grubs, with the head furnished with strong ochre-coloured or chestnut jaws, armed with two well-defined teeth at the extremity, with a third, which is sometimes much smaller, and sometimes little more than a tubercle on the inner side,* and can feed, well protected in the thick fleshy gall-growth, unless dragged out by insectivorous birds, until the time comes for them to leave the gall and turn to the chrysalis-state in the earth.

Here again their customs of life are a great protection to them. In my own investigations of the habits of the grubs I have found that on being disturbed, even if not apparently quite full-grown, they almost invariably buried themselves in the earth and constructed their earth-cases. These cases (where I was able to watch the process) were built up by the maggot holding some portion of its surroundings with the tail-end, and then adding material until it formed for itself an obtusely oval case, lying in the earth chamber from which the material had been taken. If the earth-case is broken before the maggot has turned to pupa, it will thoroughly repair it, or in winter I have found that they will bear being frozen stiff, and on being thawed will at once bury themselves and begin constructing or reconstructing their cases.

The time occupied from disappearance of the maggot to appearance of the beetle, in the instances of Turnip and Cabbage infestation which I watched in summer, was never less than about fifty-four days, and never more than two months. The infestation is to be found at the roots of many kinds of the Cabbage tribe, as, for instance, Rape, Common and Swede Turnips, Cauliflower, and Hearted and Red Pickling Cabbage, &c., and may be present during all the warmer part of the year in its different stages, and even during winter maggots are to be found in the galls.

It is often to be found together with the fungoid disease variously known commonly as Club in Cabbage, and as Anbury or Finger-and-Toe in Turnips; but the two attacks may be distinguished by the root-galls being mere lumps, single or several grown together, and smooth and healthy looking outside, and inside either solid or (as attack progresses) more or less hollowed out until the maggot's work is

* See figs. of jaws in paper on Turnip and Cabbage-gall Weevil, in the 'Entomologist,' vol. x., by E. A. Ormerod.

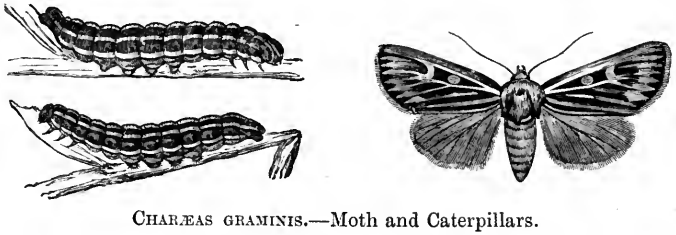
done, and it has left the empty decaying gall. The Club is a great irregularly-formed mass which gradually cracks and putrifies.*

A most commonly used remedy for gall on young Cabbage is just scraping off the galls with the nail (or in any convenient way) at the time of planting out. But where any attention is given to the subject the principle of prevention lies in such measures as rotation of crop, which will allow of the beetles being developed and gone before a crop suitable for their infestation is again put in. Also in destroying the infested stumps by burning. If they are merely thrown aside the weevil-grubs will feed on uninjured within the galls, and in due time go through the later stages of their development undisturbed. Therefore leaving the infested stocks about, or digging them in, or throwing them in rot-heaps, are all of them practices leading to continuance of weevil-presence.

Trenching does good in garden cultivation by putting the weevils down to a depth from which they cannot come up, and in the case of this insect infestation, as well as in the Slime-fungus infestation of Club and Finger-and-Toe, the application of lime or gas-lime is beneficial.

CORN AND GRASS.

Antler Moth; Grass Owlet Moth. *Charæas graminis*, Linn.



CHARÆAS GRAMINIS.—Moth and Caterpillars.

Antler Moth caterpillar attack, it will be remembered, was one of the most widespread infestations reported in 1894, and it was of considerable interest to find whether it would reappear in the same district in the past season. This it has done to some degree, but by no means to the extent recorded in the 1894 attack.

* Large figures from life, in photogravure, of Club, Anbury and Finger-and-Toe, full account of the attack, and measures found serviceable in greatly lessening the injury caused by Slime-fungus, or *Plasmodiophora brassicæ*, will be found in my 'Sixteenth Report on Injurious Insects.'—ED.

In that year the first reports, which were sent on the 22nd of June and a few days later, noted the caterpillars as making considerable havoc to the grasses on the hill-pastures in the western part of Roxburghshire, also in the adjoining counties of Dumfries and Selkirk; likewise the appearance (in immense numbers) of grubs, doing extreme damage in the highlands of the South of Scotland, was reported.

The complete observations of the summer of 1894 (see 'Eighteenth Report on Injurious Insects,' with names of contributors appended to their communications) noted this caterpillar outbreak as "having been more or less general over the hill country of Kirkcudbrightshire, and over the adjacent sheep-farms in Ayrshire, the Dumfriesshire hills, and the contiguous districts in Lanarkshire, Peebles, Selkirk, and Roxburgh. Seven counties were affected to my knowledge, and there may be more."—(R. S.)

The most westerly locality from which I had a report was Hawick, in Roxburgh, and this, measuring across to the south-eastern border of Ayrshire, would give a measurement of the length of the more or less infested area of about a hundred miles; the greatest breadth might be estimated at about thirty miles.

In the past season (that is, 1895) the first observation of the appearance of the Antler Moth caterpillars was sent me on the 24th of May, by Mr. W. Gray, from Tanlawhill, Langholm, Dumfriesshire. This was nearly a month earlier than the first report of 1894, which was forwarded on the 22nd of June; and the grubs sent by Mr. Gray were still of various sizes, from very small to perhaps about a third or half-grown. Mr. Gray observed:—"I send you some of the Antler grubs, which were so bad last year. They have made their appearance again here this year, and I fear will be quite as bad as last season. . . . I hear that they are very bad in Roxburghshire."

No more information was sent me until, on the 12th of September, Mr. Robert Service, of Maxwelltown, Dumfries, who had observed the infestation in the previous year over a large extent of country, wrote me as follows, in reply to my enquiries:—

"I have not been quite so much amongst the hills this season as usual, but with the exception of a patch of country just on the extreme corner of Lanarkshire that runs into Dumfriesshire, just behind Queensberry, I neither saw nor heard of the ravages of the 'hill-grubs' to the eastward of Nithsdale. At that place, at the farm of Nunnerie, there was a good deal of damage done to the grass in May and early June.

"On the westward of Nithsdale there was again a pretty widespread attack in the parish of Carsphairn.* These were all that I

* Carsphairn, a district in the northern part of the shire of Kirkcudbright, where the Antler Moth caterpillars did much damage in 1894.

could hear of, and they did not attract any public notice. Compared with last year, the attacks in both localities named were insignificant." —(R. S.)

The chief points of interest in this attack, independently of its great extent in the first year of its appearance, appear to me, firstly, as shown by the paper (see p. 32) on the Spotted Daddy Longlegs or Crane Fly (the *Tipula maculosa* scientifically), that, bad as the mischief is that is caused by the grubs of the Antler Moth, yet that the whole of the destruction on the pastures is not always to be laid to their charge; and secondly, that although by those not accustomed to notice insect presence, excepting when in full career of ravage, the great outburst of 1894, and presumably the lesser one of 1895, were looked on as sudden and unaccountable appearances, yet this was not the case; both had their forerunners.

On the 7th of July, 1894, Mr. Robert Service, of Maxwelltown, Dumfries, a perfectly well qualified local observer,* remarked, regarding the presence of this "hill-grub":—"Just now complaints are rife from farms in many parts of the wide district lately ravaged by the Voles. As usual, the farmers look on these 'hill-grubs' as very sudden arrivals, but this is not the case, for last autumn [1893, Ed.] the moths which these larvæ produce were in extraordinary swarms, and far in advance of their normal numbers." And in the following year (1894), on the 31st of August, Mr. Service wrote to myself, that "on Thursday (yesterday) I saw a wonderful sight on a hill-side in Upper Nithsdale, on a farm where the 'hill-grubs' had not been conspicuously present. About 10 a.m., when I arrived at a place where *Juncus squarrosus* was the prevailing plant, the Antler Moths were in full flight,—in thousands and thousands,—in all directions. This flight continued till well after midday, when it in a great measure ceased, although the moths were to be seen here and there the whole afternoon. Just before the gloaming they began to fly very numerously."—(R. S.)

How far alternating appearance of grubs and moths may have occurred elsewhere in the infested district, we do not know, not having the benefit (except in the above various local observations) of the notes of a skilled entomologist; but so far as they extend the above records are valuable for future guidance; and *precise* coincidence of locality in moth and grub is not of great importance in considerations of this kind in a greatly infested district, more especially in a case of this nature, where the larvæ are notable for their migratory powers.

The figure at p. 18 shows the size and markings of the moth and caterpillars. The former takes its name from the somewhat antler-like markings on the brown fore wings; the hinder wings are brown or

* See "Notes for Naturalists," in 'Dumfries Courier and Herald,' July 7th, 1894.

greyish. The eggs are very numerous, and are laid in the ground, or at the base of the grasses on which the grubs feed. These eggs soon hatch, and in regular course the young caterpillars feed awhile on the soft parts of the grass-shoots, then hybernate and come out again to feed in the following spring.

The caterpillars when full-grown are about an inch in length, with brown head, body of a bronzy colour, excessively shiny on the upper part, and divided by three pale longitudinal lines, two of these pale stripes meeting, or almost meeting, above the tail (see figure, p. 18), and another pale and narrower line running lengthwise beneath them.

It is evident from last winter's experience (that is, from the temperatures of February, 1895), that a severity of cold both much greater and also longer continued than is usual in this island does not avail to clear off this pest. Nor can this be expected if we consider the localities recorded in the observations on the geographical distribution of this infestation in Finland, by Prof. Odo M. Reuter.*

Prof. Reuter begins his observations as follows:—"The Grass-Owlet† (*Charæas graminis*, L.) is widely distributed, especially in the north. In Greenland, Iceland, Scotland, Courland, Russia, Norway, and especially in Sweden, the devastation of meadows by the caterpillars of these moths has long been known. . . . In the last ten years [preceding 1892, the date of report, Ed.] the caterpillars of the Grass-Owlet have also appeared in Finland in very destructive numbers. In the year 1880 ravage from them was still unknown; only in the parishes of Saltvik and Geta, in Aland, was there some amount of harm caused by these grubs.‡ This year, however, in nearly all the Governments, was known as being a bad hay-year. The cause assigned for this was the cold spring, and, later on, the long-continued drought.

"But by the middle of June [in 1881] the caterpillars suddenly appeared in the district of Helsing (Government of Nyland), and shortly afterwards enormous devastations were reported from many places."—(O. M. R. *loc. cit.*)

The further spread of the infestation year by year in Finland, up to 1891 inclusive, is given by Prof. Reuter, with names specified of the Governments, and of the parishes or localities therein, to which its

* 'Zur Kentniss der geographischen Verbreitung der Graseule in Finnland,' von O. M. Reuter, mit einer Karte. Fennia, 5, 12. Helsingfors, 1892. Knopio O. W. Backmans boktryckeri. 1892.

† "Eule," in German, equivalent to Owl or Owlet, or *Noctua*, scientifically referring to the nocturnal habits of the moths.

‡ Aland is the chief of a group of small islands lying to the west of the south-western extremity of Finland.

seriously injurious presence extended. To these are added some considerations of the geological nature and characteristics (as of soil, neighbourhood of coast, &c.) of the land affected, the nature of pasture-land attacked, and details of the migration of the caterpillars, when their ravage was complete in one place, to other grasses or crops, as to Oats, in a lesser degree to Barley, and occasionally to Rye.

Prof. Odo Reuter's paper, which extends to ten pages, with a good map showing localities and degrees of attack, appears to me of rare value, as giving what is so seldom obtainable—information from a skilled and reliable source of the first appearance of a bad crop-pest in a great country, with data year by year of its injurious spread until it has made good its foot-hold. It gives much for consideration, and I beg to offer my best thanks to Dr. Enzio Reuter, Consulting Entomologist, of Helsingfors, for presenting me with a copy of his brother's work.

The chief remedial measure which has been practised in this country is firing the pastures, and thus destroying the heath and mountain plants together with the grass, and in this way getting rid of the caterpillars sheltered amongst them. In the very bad attack of these caterpillars to mountain ground in Glamorganshire in 1884, the smoke of the mountain fires was especially mentioned as showing the large area and the severity of the infestation requiring such measures to check it.

But besides the direct destruction of the pests by fire, there is the important consideration that the caterpillars have been found to have an intense dislike to the burnt surfaces, and will move away with great rapidity when in their migrations they come on burnt land. Thus it would appear a band of fired ground might be used as a protection where the migrating bodies are moving to more valuable crops, and also in directing their course towards any neighbouring stream or pool, or peat-hole, which even in natural circumstances the caterpillars on the march will fall into in such extraordinary numbers as to make it appear that whether wet or dry they continue their course right onward.

In my reports of 1884 it was noted that at Treorky Station (on the Rhondda branch of the Cardiff and Merthyr Railway) the mountain brook running from the Fforch Mountains was thick with myriads of these caterpillars, which had been drowned by falling into it during their march across the side of the mountain.*

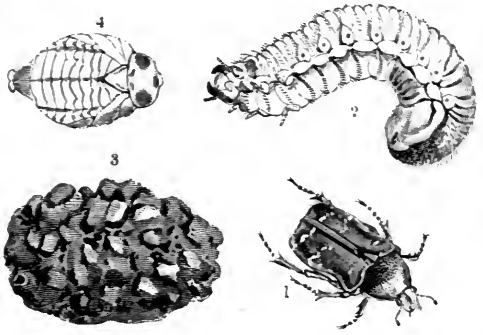
In 1894 Mr. Service reported that a party fishing for five or six miles down the river Ken, in Kirkcudbrightshire, found all the trout they caught perfectly crammed with these caterpillars.

Their determination in their onward march may certainly be well

* See my 'Eighth Annual Report on Injurious Insects.'—Ed.

turned to account by digging ditches across their path. These, if filled with water, will destroy myriads, or, if dry, may be equally well utilized by driving sheep along them, or otherwise trampling the caterpillars to death; but where it is practicable, directing the migratory hordes into the water by judicious firing of the dry grass and plants appears to be the simplest course.

CHAFERS:—Golden Chafer. *Cetonia aurata*, Linn. **Rose Chafer.** *Phyllopertha horticola*, Linn. **Common Cockchafer.** *Melolontha vulgaris*, Fab. **Summer Chafer.** *Rhizotrogus solstitialis*, Linn.



CETONIA AURATA, Golden Chafer.—Beetle, grub, back of pupa, and earth-cocoon.

Presence of the four kinds of Chafers mentioned above was reported during the past season. Of these, the three kinds first named are always more or less present, and sometimes (especially in the case of the Rose Chafer) seriously mischievous. The fourth of those named, the Summer Chafer, although sometimes noticeable in great numbers, and (as I have seen them myself on the Severn cliffs in west Gloucestershire) fairly loading the low-growing bushes, or trailing boughs of the wild *Lathyrus* Pea, has never been reported to me as causing real damage in this country, either in the beetle or maggot state.

All the above kinds of chafers are much alike in their method of life. The beetles feed chiefly on leafage of various kinds, or on flower petals, or stamens. The Cockchafers mainly frequent leafage; the Rose Chafers, although hurtful to leaves, are very injurious to various kinds of flowers, especially to Roses; and the Golden Chafer infests flowers, and is especially injurious to Strawberry-blossom, and also to Turnips left for seed, by destroying the anthers of the stamens; the Summer Chafer is seen on the Continent hovering in vast swarms

round different kinds of trees, but does not appear to be credited with doing much harm in beetle state.*

In their grub or larval state the four above-mentioned kinds of chafers are much alike, excepting in difference of size when full-grown (see figures).† (That of the Summer Chafer is not given on account of its similarity to that of the Cockchafer.) They are fleshy, whitish or yellowish grubs; somewhat cylindrical until near the tail, which is enlarged to a kind of blunt bag-like shape, and is of a bluish colour from the enclosed excrementitious matter. The head is large and horny, and armed with strong jaws; and the grubs are furnished with a pair of very noticeable legs on each of the three segments next to the head.

All the four kinds of larvæ (or grubs) are so very much alike in their first stages, that I believe it is impossible for any one but an expert to distinguish certainly between them. After a time they are distinguishable (in a general way) by their respective sizes; but for practical purposes it may, I believe, be safely considered that where a great infestation of some special kind of chafer-beetle has been noticed on special fields, that the chafer-grubs found on that spot are the progeny of the preceding beetles. This may seem too obvious to need pointing out; but I have known pseudo-scientific investigation come to a very inaccurate conclusion for want of a little attention to the above considerations.

The grubs of the above-mentioned kinds of chafers feed much at grass-roots, but are by no means wholly confined in their ravages to grass-land. The Cockchafer grubs may be found at roots of various field-crops, fruit-trees, as Apple, Plum, &c., and even at Larch-roots; and the Golden Chafer grub is especially injurious to Strawberry-roots, and is also to be found in ants'-nests.

The Golden Chafer, sometimes known as the Green Rose Chafer, *Cetonia aurata*, Linn., figured at p. 23, is of a bright metallic green or golden green above; coppery, with a rose tint, below; the wing-cases are punctate, and marked with spots or streaks of white or ochreous colour, so placed as often to look like cracks across the metallic green of the wing-case. The horns are ended by a club much like that of the Cockchafer (see figure, p. 30), excepting that it has only three leaves or plates, whereas that of the Cockchafer has seven plates in the male, and six in the female. The wings are large and membranous, of a brownish colour, with horny veins; and when the beetles are seen

* *Vide* Kaltenbach's 'Pflanzenfeinde,' p. 86.

† In 'British Coleoptera,' by Canon W. W. Fowler, it is observed at page 50, vol. iv.:—"The larva of *Rhizotrogus* appears very closely to resemble that of *Melolontha*, and does not need a separate description."

in flight on a sunny day they are very conspicuous objects, and, if quietly watched, remarkable for the care with which they will choose a place (presumably) for egg-laying by floating round in the air till an available crack in the ground is selected, and then with good aim sweeping down into it and disappearing.

In the neighbourhood of Isleworth, where Strawberries are grown in fields of many acres to supply the London market, I have had the beetles brought me in great numbers, and to a greater or lesser extent they are a very common infestation; but the following note, sent me on the 25th of May (1895) by Mr. Leonard Micklem, from Yardley House, Chingford, Essex, records such an unusually numerous appearance of this beetle that it is worth adding to former observations:—

"I am sending you by post three specimens of a green beetle which is becoming an insupportable pest in my garden, in the hope you may be able to suggest some method of eradicating it. The beetle appears annually with the Apple-blossoms, which it devours greedily, and is now paying attention to Medlar and Iris-bloom. My gardener has killed more than 2000 already this season, but even this appears to effect no diminution in their numbers."

A few days later Mr. Micklem, writing further regarding the Golden Chafer attack, remarked that the capture that day was 373, "and this in spite of daily destruction since their first appearance."

The life-history, just shortly given, appears to be that the chafers lay their eggs in the ground, including in this such places as heaps of rich earth and old cucumber-beds in gardens, and the maggots feed on roots, as of grass, &c. Probably also they are very injurious in Strawberry-beds, as John Curtis notes:—"I have seen very fine young plants die suddenly, and on taking them up, the roots had invariably been eaten through close to the surface, and a large maggot was always found a little below the spot."—(J. C.)*

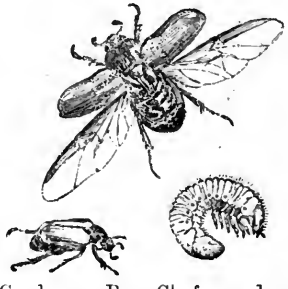
The grubs (says the same authority) may be distinguished from those of the Cockchafer, which otherwise they very much resemble, by being downy, and covered with transverse series of short hairs, and the *feet are pointed*, whereas the feet of the Cockchafer grubs are blunt, and *rather dilated at the tips*. Also the Golden Chafer grubs have a large horny bright-coloured rusty spot on each side of the segment next the head.

The grubs are considered to live underground for two or three years, and then (in the second week in June, in an instance specially watched) to form their pupa-cases in the ground, covering the outside of these large earth-cocoons with pellets of earth or dirt which have passed through their bodies (see figure 3, p. 23).

* '*Cetonia aurata*.' Paper by Ruricola (= John Curtis) in 'Gardeners' Chronicle,' vol. i., page 452, 1841.

The duration of the attack of the beetles depends very much on the weather. In 1841, when they were specially watched by Curtis, he noted:—"This spring, after feasting on the Strawberry-blossoms, they proceeded to a bed of Turnips in flower, which was reserved for seed, and they are now making a repast of the Roses; thus they migrate from one set of flowers to another until September if the seasons be fine, but if wet and cold weather sets in they become paralyzed and die."

Measures of prevention and remedy are very similar to those for other chafer infestation mentioned at page 32.



PHYLLOPERTHA HORTICOLA, Garden or Rose Chafer, and maggot, natural size; and magnified with wings expanded.

The Rose Chafer, or Garden Chafer, figured above, has for some years back been one of our especially bad pests, causing very serious injury to grass-land, and reports of it are again given to show the wide extent of its continued ravages. In Norfolk, on the east of England, and in Galway, on the west of Ireland, it has been doing its mischievous works; and on the Welsh mountains near Barmouth, as amongst the gardens of Surrey and other localities in beetle state, and at grass-roots in various localities in grub state, its obnoxious presence has been remarkable.

The beetle is of the shape and size figured above (lower figure or natural size); the head and fore body bright green; the wing-cases bright tawny. The grubs are exceedingly like those of the Cockchafer, only smaller. They are white or ochreous, with chestnut or ochrey-coloured heads, and jaws darker at the tips; when at rest they lie with their bodies curved, but when disturbed they straighten themselves out, and are very active; and lately I have found, by timing the progress with the help of a foot-rule and the second-hand of my watch, they could travel from five to six inches in about half a minute. When full-fed they turn to the chrysalis-state in cells some way beneath the surface of the earth.

On the 3rd of June information was sent me by Mr. P. H. Foulkes, from the University Extension College, Reading, of beetles, which

proved to be Rose Chafers, having been sent him from a locality in south Hampshire, where a lawn had been attacked, and considerable damage done.

One of the earliest observations, however, of appearance of the Rose Chafer beetles in great numbers in the past season was sent on the 6th of June by Miss Hampson, from Tyn-y-Celyn, Llanelltyd, Dolgelly, N. Wales. In this Miss Hampson mentioned that on the previous Sunday (that is, the 2nd of June) swarms of the enclosed insect appeared on the neighbouring mountains above the Mawdach or Barmouth River, and that, at the time of writing, they were at the lower levels also.

At the above date notes were also sent by Miss Dobell, of Detmore, near Cheltenham, of reappearance of the Rose Chafers in great numbers on her fields, where they have done much mischief in previous years, and from which she has obliged me from time to time with observations of these and of Cockchafer attack which was likewise present. On the 6th of June Miss Dobell wrote as follows:—"You will, I think, be sorry to hear that we have the 'Rose Beetle' in swarms. I suppose these beetles are from the grubs of 1892. We first saw them on Monday, June 3rd. They began to rise about 12.30, and by one o'clock my *Clover* was covered by couples of beetles. My nieces set to work and gathered them into cups with water, and had to be very careful to put the hand *under* the Clover before touching it, or they fell into the grass. For two days we have been picking with the help of a boy, and gathered a large pint and a quarter of the poor little things; but to-day I have given up in despair, for the whole field, when the sun came out, was black with them flying. My man says all my neighbours' fields are the same. I sent him up to my top field that is not put down for hay, and he said there were none on the two sides, but there seemed to be a band in the middle thick with them, like a swarm of bees, going to other fields. I have none on my Roses or trees; all seem on the flowers or Red Clover, that we have a great deal of."

On June 15th Miss Dobell reported further:—"I am sorry to say the Rose Beetles kept on in thousands for a week, flying about over the fields till 1.30 or 2, and then again settling on the Clover till next morning, where for a week they kept flying; after that we have had about fifty or more picked off the yellow Scotch Roses. Only a *very* few have been on the other Roses."

The following observation, given in the 'Dublin Farmer's Gazette' for June 15th, 1895, at p. 328, is of a good deal of interest as showing the presence of the *Phyllopertha horticola*, or Rose Chafer, and also the serious damage caused by this beetle to various kinds of garden crops, as far west in Ireland as the county of Galway:—"*Co. Galway.*—

Every leaf in my garden on Peas, Roses, Strawberries, Raspberries, is being eaten, leaving nothing but lacework, by what I think is the Rose Bug. I never saw such a quantity. The hearts of the Roses are swarming with them." Samples accompanying were submitted to Mr. G. H. Carpenter, Consulting Entomologist to the Royal Dublin Society, who identified them as the *Phyllopertha horticola*, giving the requisite advice.—(Ed.)

On June 13th, I was favoured with a note from Dr. C. Theodore Williams, of 2, Upper Brook Street, London, W., regarding beetles which were infesting Roses in his garden at Witley in Surrey. These also proved to be the *Phyllopertha horticola*, or Rose Chafer, and were doing much mischief by eating "the petals of all the Roses."

On the 20th of June I had the following useful note sent me by Mr. T. P. Newman, of Hazelhurst, Haslemere, Surrey, in which district* the Rose Chafers, which were so mischievous in beetle state to Roses and various kinds of leafage, and most seriously destructive in maggot state to roots of grass in pasture-land in 1893, are still troublesome.

Mr. Newman remarked:—"There would seem to be no royal road to destroying this pest; but it is comparatively easy to destroy many thousands, and this must surely have some effect in both present and future depredations. The beetles are especially fond of the fully-opened and fading blossoms of *Rosa rugosa*, as well as of the Scotch, Austrian, and Persian Roses. It is quite worth considering whether it is not worth while to plant a few bushes of *Rosa rugosa* to attract the beetles away from fruit-trees. They cluster in groups of a dozen or more on a flower-head.

"By holding a small fish-can under and tapping the blossoms, the beetles, which are very suspicious, drop into the can; as they are sluggish in the evening, this is the best time. In case they are lively the lid of the can is shut down on them. Scalding water kills them, and to make sure of destroying the eggs, they are finally burned on the rubbish-heap. In this way I destroyed about a thousand a night in about half an hour for three or four nights. The main attack does not last much longer. Isolated specimens and pairs are, however, still abroad."

This observation of Mr. Newman's as to short duration of the main attack is well worth notice, for in an attack of this kind it is very apt to happen that while people are thinking what to do, or whom to ask about it, the mischief for the present attack, and egg-laying for the next, is completed, and the insects gone.

* See my 'Seventeenth Report on Injurious Insects,' pp. 24—26.

PHYLLOPERTHA HORTICOLA, *Garden or Rose Chafer, seriously injurious to young crops of field Turnips in Norfolk.*

On June 15th I was favoured by Mr. E. A. Atmore, F.E.S., of King's Lynn, Norfolk, with observations of the great abundance of the Garden or Rose Chafer Beetle in that neighbourhood, and that (by that day's post) he had received news of great damage being done by this pest to the young Turnips near West Dereham, Norfolk, and that it was stated fifty acres sown with Turnip would have to be destroyed by reason of the ravages of this beetle.

Mr. Atmore, who is a skilled entomologist, as well as an experienced observer, naturally thought that there might be some mistake, and that it was really the Turnip Flea Beetle (*Phyllotreta nemorum*) and allied species which were the cause of the mischief. Beetles were sent him for scientific investigation which had been taken from the fields, and these proved to be the Garden Chafers; but to make sure that they were the real cause of the damage, and not merely coincident with it, Mr. Atmore instituted careful investigation, and found the case was as stated.

On the 10th of October Mr. Atmore was good enough to give me the following detailed report, which I give at length as an important record of the damage caused by this beetle to a field crop which (although the chafer is known to be pretty nearly omnivorous in its feeding) has not, so far as I am aware, been previously noted as severely attacked by it.

Mr. Atmore wrote me as follows:—"In answer to your enquiry and request for information upon the alleged *Phyllopertha* attack on Turnips, I am now able to state that the attack and subsequent complete loss of Turnips upon the large acreage referred to in my correspondent's letter was caused by *Phyllopertha horticola*, and not by species of *Phyllotreta*.

"I give here extracts from my correspondent's letter, Mr. R. C. Winearls, of West Dereham, Norfolk, who writes, June 13th, 1895:—'I am sending you to-day several specimens in a box. . . . One friend of mine who has supplied me with these specimens has had fifty acres of growing Turnip-plants entirely eaten off, and they will have to be sown again. They are equally rapacious with the leaves of Peach-trees, Apple, and even the Peas in the garden they are taking off. . . . Can you tell me their proper name? . . . Please return me three or four of these pests, and retain the rest for examination.'

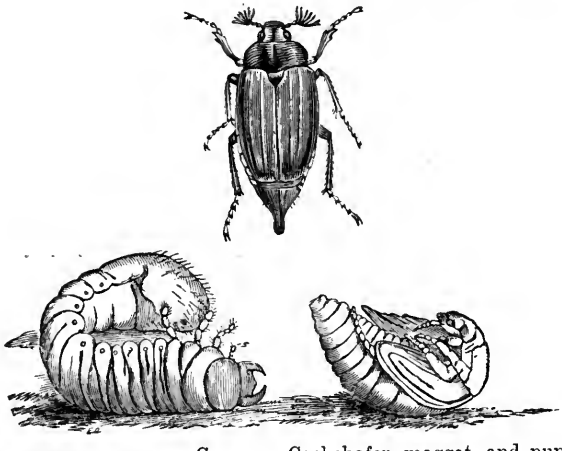
"The beetles were certainly *Phyllopertha horticola*, Linn., and from subsequent enquiries made, I have been able to ascertain that the Turnip-plants were entirely eaten off in a day or two by swarms of this pest—that Turnips in the neighbourhood of Beechamwell, Marham, and Barton Bendish (Norfolk), suffered considerably from their

attack. In the course of correspondence, I pointed out to my informant, Mr. Winearls, that these beetles would *not* be likely to feed *by night*, and that the damage would be done *by day;* that the beetles would be found to be sluggish at night, and many of them concealed in various ways. These remarks my correspondent found upon further investigation were correct.

"Personally I may add that I have ound *P. horticola* excessively abundant everywhere in this neighbourhood at the end of May and during June this year. During my entomological outings they would seem to have been especially partial to the foliage of Birch-trees, and from some of these trees I have seen the beetles fall like a shower of hail when the branches have been tapped with a stick or shaken."—(E. A. A.)

Where an infestation occurs, as is too frequently the case with this especial one, year by year in the same district, if growers were on the alert and ready to destroy the beetles on their very first appearance, it could not fail to make a deal of difference in amount of egg-laying, and consequently on future amount of maggots.

So far as the observations lately sent me show, there is present evil and consequent danger of recurrence of attack next year from the quantity of maggots. Miss Dobell, writing to me on the 4th of Oct. from Detmore, near Cheltenham, mentioned that the maggots were perfectly swarming on her fields just under the grass, and added, "I have just been out, and with a rake have thrown up thousands."



MELOLONTHA VULGARIS, Common Cockchafer, maggot, and pupa.

The Common Cockchafer has been so repeatedly written on, both scientifically and popularly, for almost countless years, that until some advance is made in practicable methods of getting rid of the grubs, it appears almost impossible to add any more serviceable observations.

Therefore I do not insert the various Scotch and English notes of its presence sent me during the past season; but as its larva, or grub, is to a great extent taken as the type (save in size, or some few peculiarities) of the other three kinds here mentioned, I add the description by the Rev. Canon W. W. Fowler as being serviceable for trustworthy reference:—

"The larva of *Melolontha vulgaris*, the Common Cockchafer, has been described by many authors; it is large, thick, and fleshy, of a dirty white colour, with the head ferruginous and shining, and the legs pale ferruginous; the antennæ are a little longer than the mandibles, and are 4-jointed; the anterior pairs of legs are rather shorter than the intermediate and posterior pairs, which are of equal length; the segments are transversely rugose, and the last is large and apparently divided by a false articulation; the upper surface of the body is furnished with short upright bristles, and long separate hairs which are intermingled with these; the pupa is rather large, with the abdominal portion slightly curved, but does not present any striking peculiarities." *

The Summer Chafer, *Rhizotrogus solstitialis*, L., is about half the size of the Cockchafer, and very like it, excepting not being prolonged into a tail-like extremity, and also in being much more covered with longish fine hair. The length averages three-fifths of an inch; the general colour clayey or yellowish; the wing-cases, with the suture and outer margin, somewhat darker than the disc, which has four slightly-raised whitish lines; the legs reddish.

The larvæ, as mentioned at p. 24, are exceedingly like those of the Cockchafer.†

On July 16th some specimens of this chafer were brought me as samples that appear every year in the higher part of St. Albans, near the cemetery. The observer had not noticed them low down, but flying round the chimneys, and on the green trees.

This agrees with the description of their habits given by Dr. Taschenberg (see reference):—"In the evenings from the second half of June onwards the males swarm around the low trees over cornfields, and round the heads of foot-passengers, whilst the females rest on grass, or corn, or other plants near the ground." A few days after pairing, egg-laying begins. The white roundish eggs are laid singly in the earth, up to twenty or thirty by one female. From this frequent creeping in and out, the hair is gradually rubbed off, so that the

* 'British Coleoptera,' Fowler, vol. iv. p. 51.

† A minute description will be found at p. 44, part ii., of 'Praktische Insekten-Kunde,' by Dr. E. L. Taschenberg.

specimens captured towards the end of the time of flight of the chafers are often bare.

After three or four weeks, up to the end of July, the young larvæ come out, and feed in the same manner as Cockchafer grubs; they go down deeper for their winter sleep. Next spring they come out again, change their skins for the last time at the beginning of May, and are more voracious, and consequently more destructive, than they were previously.

About the end of the month above-named they go into chrysalis state. The chafers appear from the middle of June to the middle of July; and in German observations are stated to feed, amongst other things, on Fir-leaves, and the infestation has been noted in one district as mischievous in autumn at the roots of young Rye.

Observations of this chafer in grub state have never been sent me; but the above notes taken from Dr. Taschenberg's 'Praktische Insekten-Kunde' may be useful for reference.

In regard to methods of prevention and remedy, these have been fully entered on previously. But it may be just mentioned that with regard to getting rid of the beetles, the most practicable plan (in this country) appears to be shaking them or beating them down at whatever time of day, or in whatever kind of weather, they are most sluggish, and destroying them.

For the grubs,—if there is a possibility of turning them up to the surface from the depths they have gone down to in winter, it would be a thoroughly good treatment. Other measures, such as turning on pigs, or poultry, are more or less useful, and also taking care that the larger wild birds which follow the plough on infested land are not disturbed.

Spotted Crane Fly. *Tipula* (*Pachyrrhina*) *maculosa*, Hoffmansegg.*

The leather-jacket grubs of the Daddy Longlegs, or Crane Flies, are one of our yearly farm troubles. The common Daddy Longlegs, *Tipula oleracea*, has been so repeatedly written on for fully scores of years, that it cannot be desirable to say more about it, excepting that whilst preventive and remedial measures which would certainly lessen amount of loss from its ravages in ordinary farm service are well before the public, and only need to be acted on to do much good, yet

* Figures of *Tipula oleracea* in all its stages will be found in Reports on injurious insects by Ed. noted further on, and in many others of the set; and figure of *T. maculosa* in Report for 1879, p. 10.

we certainly need knowledge of treatment reasonably practicable on the wide scale required for outbreaks on marsh pastures, or mountain pastures, or other great areas of grass-land.

In the course of the observations sent me during 1894 regarding the ravages of the Antler Moth caterpillars in the south-west of Scotland, Mr. R. Service, of Maxwelltown, Dumfries, mentioned the great injury which was also sometimes caused on the upland pastures by the devastations of *Tipula* grubs; and in the past season specimens were sent me from Antler Moth infested pastures, which proved to be larvæ of the *Tipula maculosa*, or Spotted Crane Fly.

On the 24th of May (in the past season), Mr. W. Gray, writing from Tanlawhill, Langholm, Dumfries-shire, N.B., sent me accompanying some quite young caterpillars of the Antler Moth of various sizes, from very small, up to as much as a third or half-grown. He mentioned at the same time the injured appearance of the grass, but that on searching for the caterpillars there seemed very little sign of them, which he ascribed to their being still so small that they escaped observation.

However, about a month later, the true cause of the damage was found. At the beginning of July Mr. Gray wrote me again as follows:—"By same post as this I send you some maggots which one of the shepherds brought me, saying that he found them where the grass was worst damaged, and that they were in great numbers. As the Antler grub is *not* in very great numbers to account for the large destruction, these maggots may destroy grass also." Mr. Gray further remarked that though the Antler caterpillars were not so plentiful as in 1894, there was much more damage being done to the grass.

A liberal supply of grubs was sent me, which on careful examination proved to be larvæ of the *Tipula maculosa*, according to the description given in Curtis's 'Farm Insects,' p. 450. The maggots of the Spotted Crane Fly are distinguishable from those of the common Crane Fly, or Daddy Longlegs, by being lighter coloured, softer, and a good deal smaller. According to John Curtis's measurements, they are only three-quarters of an inch long, and about as thick as a large crow-quill, whereas the larger kind are about an inch long, and as thick as a goose-quill; but independently of size when full-grown, the two kinds differ in the shape and arrangement of the four tubercles at the upper edge of their truncated tail extremity.

In the grubs of the common Crane Fly (*T. oleracea*) there are four fleshy tubercles, more or less pointed; but in the Spotted Crane Fly the truncated tail terminates above in two spreading hooks, with two short teeth between them: this peculiarity was very noticeable in the specimens sent me. Besides these, in both kinds of grubs there are two spiracles in the middle of the truncated end of the tail, and two

tubercles below; and John Curtis notes, in the case of the Spotted Crane Fly, that there are two fleshy protuberances, which can be dilated or contracted at pleasure, and help the maggots in locomotion. The grubs, like those of the common Daddy Longlegs, are cylindrical and footless; their small *brown* heads are retractile into the fleshy body, and furnished with a pair of minute black jaws.

In spring they change to the pupal state, in which, like the common Crane Fly (the *Tipula oleracea*, of which figures have been frequently given in these Reports), they stand upright in the ground, with about half of the body exposed, showing the cases above the folded-down wings, and also above the legs, lying centrally between them.

The flies are about half an inch long, with an expanse of wing of about one inch. The colour a very pretty yellow, much spotted with black. The male has eight black spots along the top of the abdomen, the female six, with (in each case) other black spots or dots below. "The wings are smoky yellow and iridescent, with brown nervures, a yellow pinion edge, and stigma; the poisers ochreous, and the legs mostly ochreous, with black feet." *

These yellow black-spotted Crane Flies may be found in May, June, and July, but whether the successive appearances are from successive broods, or difference in date of laying, appears uncertain.

For the most part the reports sent in as to *Tipula* maggot ravage make no distinction between the kinds of grubs that may be present, but now and then a trustworthy observation shows the great damage caused by this special kind, as in 1879, when Mr. E. A. Fitch, F.E.S., reported them to me as being very injurious in a nine-acre field of his at Maldon, Essex,—to Wheat after Red Clover. In April he had the Charlock (*Sinapis arvensis*) pulled, and the soil, being wet and tenacious, adhered to the fibrous roots, "and the quantities of small *Tipulæ* larvæ exposed were enormous."

John Curtis mentions that from the immense swarms of the gnats of this species on lighter arable land he inclined to think that the corn-crops suffered more in such situations from this than from the common larger kind. Also it is to be found on damp or marshy grass-land. Dr. Ritzema Bos (see *loc. cit.*) notes having himself observed it in enormously large amount on the Nordpolder, in the province of

* Detailed description of this species of *Tipula* in its different stages, with figures accompanying, will be found in the volume of the 'Gardeners' Chronicle' for 1846, p. 317; and descriptions, with much useful information regarding them, in 'Farm Insects,' pp. 449–451; in both cases by John Curtis. The most recent account I am acquainted with is an excellent one given by Dr. J. Ritzema Bos (from his personal observations) in his 'Tierische Schädlinge und Nützlinge,' pp. 595, 596. Berlin, 1891.

Groningen. The precise definition of "polder" is "marshy ground" dried by cutting canals and ditches, and the description of the province of Groningen, in Johnston's 'Dictionary of Geography,' p. 583, is, "Surface flat, low, and partly exposed to the inundations of the sea. It is rich in pasturage, but marshy in the S.E., where it is bounded by the morass of Bourtang." If we add to the light and sandy arable land, the above low-lying marsh grass-land, and the upland pastures of the S. of Scotland, besides a sort of general ravage, such as feeding at the roots of Clover and Peas, eating off the crowns of Strawberries, and damage at roots of other kinds of garden and field crops too numerous to specify, it certainly appears that this pretty yellow black-spotted kind is hardly behind the common larger grey kind in its injurious powers.

The remedies and means of prevention for both kinds are alike, and have already been given.* In these notes are given of methods of prevention of egg-laying, or of treatment of infested grass-land, including paring and burning (an excellent plan where it can be carried out at a paying cost), hand-picking, feeding stock on the ground, and cutting grass so that there should be no shelter for the flies, and the eggs and young grubs should be poisoned, and draining, as a matter of course, to put an end to the dampness and consequent coarse growth of sheltering herbage in which the flies delight; notes of stimulating applications found serviceable to drive on good sound growth, and thus save moderately injured young corn or other crop, including in these nitrate of soda, which is doubly helpful by disagreeing with the grubs, as well as encouraging growth; notes of birds found to do good by clearing the grubs, and of mechanical measures useful in throwing them open to the birds, or of so firming the soil by rolling as to prevent the grubs travelling. These and many other points are given in detail, but amongst them all is one important habit of the grubs which appears much more certain now than in the earlier observations. *This is the extent to which the grubs come up in the evening to feed on the surface of the ground.*

One of the first observations of the grubs coming in great numbers on the surface was sent me in 1880, by Mr. Whitton, from Coltness, Lanarkshire, N.B., where there was such a strong attack of *T. oleracea* larvæ that he noted he had never seen anything like it before for quantity. The grubs were noticed in moving plants in the garden, "and as many as possible were killed with the spades; the beds were left for a day or two, and then forked over lightly again. . . . *In the*

* See my 'Annual Reports' for the years 1879, 1880, 1884 (in which the subject of *Tipulæ* is entered on in much detail, pp. 19–28); 1892; and short mention in various other of my 'Annual Reports,' with figs. of the *T. oleracea*; and in that for 1879 of the *T. maculosa* also.

morning the grubs were on the walks by hundreds," and there, of course, they were easily dealt with.

In February, 1884, Mr. Berry Torr favoured me by having special observations taken at Westleigh, near Bideford, when bad grub-attack was going on; *and the grubs were found on the surface in large numbers at about one o'clock in the middle of the night.*

In 1892 I had observations from a locality in Shropshire, on the 2nd of June, of the grubs doing much mischief to a field of Turnips, and "being observed to burrow lightly under the soil during the day, *but at night to come up and crawl on the surface.*"

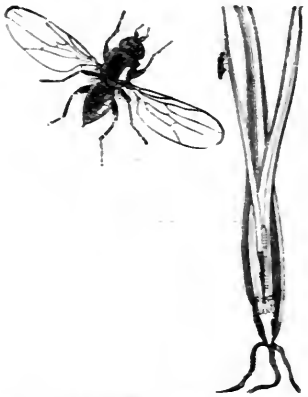
Also many years ago it was matter of observation of my late brother, the Rev. John A. Ormerod, Bursar of Brasenose College, Oxford (who both officially and as an observant naturalist was accustomed to noting the habits of agricultural pests), that Daddy Longlegs grubs came out in such great numbers by night from the grass in the College Quadrangle that in the morning it was a regular thing to clear the quantities on the walks by sweeping them up.

In the above observations only the presence of the grubs above ground is mentioned, but in the following note by Dr. Ritzema Bos, of his own personal observations of the grubs of the *T. maculosa* (the Spotted Crane Fly), it will be seen that he not only observed them above ground in the evening and by day in the dark damp weather, but was also able to watch them at work at the growing field crop. Dr. Ritzema Bos, after recording some special experiments, observed: "On the fields I saw the grey larvæ in the evenings (and in dark moist weather also in the day) leave the earth and feed above ground; still the underground ravage was of much the most consequence." *

In the coming season some more observations of the extent to which *Tipulæ* grubs come out to feed at night would be very desirable. It is not reasonably possible to roll in the middle of a February night, however mild the weather may be; but at a better time of year, in cases where great breadths of marsh pasture were being ruined by Crane Fly grubs, it would be well worth while to see if they were up in the evening or at night, or in damp weather by day, and if so, to try the effect of a Crosskill's roller, or a Cambridge or ring-roller. Hitherto we have not, I believe, found any remedy for infestation of large areas of marsh pasture, but if rolling could be brought to bear when the grubs were above ground the expense of the rolling would be better than the loss of the grass.

* Work by Dr. J. Ritzema Bos, previously cited, p. 595.

Frit Fly. *Oscinis frit*, L.



OSCINIS FRIT.—Fly, much magnified; Oat-plant, with maggot within, and fly on leaf-blade, natural size.

Frit Fly is probably always more or less present here, and if the signs of the attack were better known so that treatment could be given before the young Oat-plants were injured past all hope of recovery by the gnawings of the maggot within them, much good would be done. As it is, the young crop withering, or the growth failing towards the middle or end of June, is commonly what draws attention to mischief being present; and by the time that samples have been sent by the grower for information as to what is amiss, and the remedy has been learnt, and the requisite application has been procured, the time has most likely gone by in which treatment might have saved the crop.

In this country the Frit Fly attack may be said to be scarcely half as injurious as it is in various parts of continental Europe, for it rarely is reported with us as injuring the ears or seed-heads, nor does it appear to extend its attacks to Barley, on which it occurs as well as Oats in various European countries, as France, Germany, and Bohemia, and to an especially mischievous extent in Sweden.

The fly is two-winged, bright shiny black, and of the shape and size figured above, respectively, nat. size and mag.; and though now and then mischief is done by the maggots of the second brood feeding in the Oat-heads, the chief damage here is from it as an infestation to the young growing Oat-plants.

The maggot feeds in the heart of the young plant. It is only about the eighth of an inch long, whitish, legless, cylindrical, with a strong pair of curved mouth-hooks in the bluntly pointed head end; and when much magnified will be seen to have a *branched* spiracle, or air-tube, projecting on each side near the head; and also two wart-like projecting spiracles at the blunt tail.

The chrysalis is rather smaller than the maggot, reddish-brown in colour, more pointed at the head than at the tail extremity, which latter appears from the size of the wart-like spiracles, which it bore in maggot state, to be strongly cleft. The branched external spiracles, or "air-tubes," near the head, are also for a time clearly noticeable. The maggots turn to chrysalids in the dying remains of the outside leafage of the plants in which they have fed, and from these (in the most specially recorded notes which I took) Frit Flies were appearing about the 9th of July.

Weather influences may be said to have very great effect on this attack, as it has been found that late-sown Oats suffer very much more from it than those put in earlier; consequently if from prolonged cold or rain in late winter, or early spring (as well as from other causes), the Oat-sowing is delayed, the crop is likely to suffer conformably.

The following notes, sent me in 1888 (*the* great Frit Fly year) by Mr. W. McCracken, Professor of Agriculture at the Royal Agricultural College, give definite valuable observation on this point.

Writing to me from the College on the 4th of July, Prof. McCracken observed:—"I send you a few specimens of Oat affected by a small grub [that of the Frit Fly, Ed.]. I am sorry to say a very large area in this part of the country has suffered similarly. The crop from which these specimens are taken is practically destroyed, except for hay. *Winter Oats and all early spring-sown fields seem to have escaped.*" * A few days later, examination of one of the badly attacked fields alluded to showed damage roughly estimated by Prof. McCracken as 90 per cent. of crop gone.

In 1889, Prof. McCracken wrote me again, from the Royal Agricultural College, on the same subject at the beginning of August:—"The Frit Fly has again been the most plentiful of injurious insects, and, as was the case last year, *the degree of injury corresponds to the date of sowing.* For example: in one field Black Tartarian Oats (the sort most largely grown here) were sown on March 29th, and enjoyed almost complete immunity from attack; in another field, sown on April 29th, over seventy per cent. of the first stems were destroyed."

The following note, sent on the 17th of June in the past season from Ossemsley Manor Farm, Lymington, Hants, by Mr. D. D. Gibb, shows bad attack following on late sowing, and also the additional evil of unfavourable weather for growth accompanying the attack, and preventing the injured plants doing something towards returning a crop by tillering. This (as it is unnecessary to say), both from

* I add italics to the above and the following passage to draw attention to the point of *early sowing*.—Ed.

inferiority of yield and unevenness of time of ripening, is very inferior to a regularly grown crop; but still some moderate return may thus be secured, if the nature of the mischief is known in time for good dressings to be applied which (weather permitting) will push on the side-shoots at once.

Mr. Gibb wrote as follows:—"I enclose a few Oat-plants taken from a field somewhat late sown that has suffered much from attacks of Wireworm and Frit Fly; in some parts the plants have been nearly cleared. The weather is still against the plants remaining being able to tiller out and fill up empty spaces, while these pests still attack and destroy the tender shoots that are sent forth from the sides."

On June 6th Mr. P. H. Foulkes, writing to me, with specimens of Frit Fly accompanying, from the University Extension College, Reading, observed:—"In the attack of Frit Fly which I mentioned, and about which I was consulted, I recommended a dressing of nitrate of soda, and this has already done good. In one part of the field soot had been applied as a top dressing, and this was left undressed with nitrate; although this part is free from weeds as compared with the nitrate-dressed portion, yet the latter portion looks much the better, and is picking up wonderfully after the attack."

Mr. Foulkes also observed:—"Last year a portion of the field was sown with Mustard, and ploughed in; in this portion of the field the Oats have been attacked to a greater extent than in the other portion, which was free from Mustard last year."—(P. H. F.) This is sent by the observer merely as an isolated record, but which may prove of interest.

The above remarks on some of the Frit Fly appearances of the past season are given just to show that where this attack is known by sight it is still present, and probably if it were better known, so that the method of failing of the attacked plants was distinguished from what is owing to other causes, much harm would be spared.

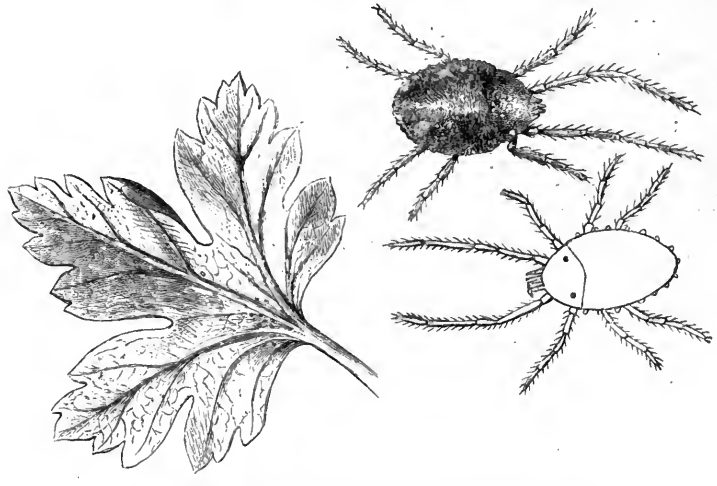
The sign of the infestation being regularly established is much of the young plant appearing to be dying towards the end of May; but if watch was kept, especially in the southerly and south-westerly counties, earlier in the month, and on the first signs of damage the cause was looked for, we could then, by the presence of the small maggot inside the shoot, distinguish this attack, and, instead of rolling as for Wireworm, or applying remedies which are no use in this case, give right treatment at once.

This consists in application of such stimulants as will best push on growth, so that all the plants which are not touched may fill up the blanks, and tillering may do all it can in good time; and it should also be noted that in cases where the plant is so destroyed that it has to be ploughed in, that, so far as is possible, it should be thoroughly buried

down. The flies come out of the chrysalids very soon, towards the middle of July; and if the infestation could be buried down altogether, by ploughing with a skim-coulter attached, or any way which put it well below the surface, much risk of recurrence would be saved.

GOOSEBERRY.

Gooseberry Red Spider. *Bryobia prætiosa*, C. L. Koch; also *Bryobia ribis*, n. sp. of Dr. Fr. Thomas.



Bryobia prætiosa, from life; B. speciosa (outline figure after Koch): both magnified. Leaf infested by Red Spider, nat. size.

Notwithstanding the unusually severe and long continuance of cold in the early part of the year, the Gooseberry Red Spider, which was the cause of great loss to growers in the spring and early summer of 1893, and also of 1894, reappeared in the middle of March and early part of April in the past season of 1895 to an amount which caused serious anxiety as to the extent of injury that might again be coming on.

The infestation, however, which appeared in such quantities with the hot bright days, disappeared again (in the localities reported to me) during the occurrence of cold and wet; and afterwards, though there was much damage on grounds where the dressings which have been found to answer were *not* applied, the damage (so far as reported) was neither so widely spread nor so serious as in the two previous

seasons. The infestation is chiefly noticed again now to record, firstly, the unusual severity of cold having *no* effect in preventing reappearance of the attack; secondly, the effect of weather in promoting or lessening the presence of the pest when once established in active state on the bushes; and thirdly, the identification by Dr. Friedrich Thomas, of Ohrdruf (the well-known phytopathologist), of specimens of Red Spider sent to him from Mr. Nixon's grounds at Great Eversden, near Cambridge, as being of a species hitherto undescribed, and which has been named by Dr. F. Thomas as *Bryobia ribis*. Thus from the minute investigations of two skilled experts it appears that we have *two kinds* of Red Spider on our Gooseberry-bushes.

As both kinds appear so like one another to general observation, and also very similar to each other in habits, the difference of species appears unimportant practically, but as a scientific point it requires mention.

On the 22nd of February Mr. F. Nixon, writing from Great Eversden, near Cambridge, mentioned:—"I am keeping a careful watch on my Gooseberry-bushes, but as yet I am able to detect nothing wrong"; and still on the 9th of March, so far as could be seen, there were no signs of the Red Spider being present.

This state of things, however, did not continue, for on the 15th of March Mr. Nixon sent me specimens of infested sprays, with the observation that he greatly feared there was every indication of another virulent attack of the Gooseberry Red Spider pest. "Last Monday, March 11th" (Mr. Nixon noted), "I was able to find one here and there. To-day I can find hundreds. Some of the buds (which are not yet open) are at the base almost surrounded by them. They appear to be just now hatching out. I shall syringe my bushes with 'Antipest' as soon as possible."

The following notes, sent me on April 8th by Mr. Walter Frost, Fruit-salesman, Covent Garden Market, are valuable as showing the great degree to which amount of attack of the Red Spider is influenced by heat, or, on the other side, by cold and wet weather. Mr. W. Frost wrote:—"I found about a fortnight ago, when we had two or three hot days, that my Gooseberry-bushes seemed almost covered with Red Spider, and at once provided myself with the wash. But the bud then was so tender that I hesitated to use it, and since the wet colder weather of the last fortnight the pest seems to have disappeared, I am afraid only to come again with sunshine. Of course, now the leaf is getting strong, and I shall wash if necessary. I hear greatly the same report from Kent. Is it possible that the Spiders, developing before the leaf, have been killed by cold and wet? I hope so."

At the same date as the above, namely, the 8th of April, Mr. F. Nixon, of Great Eversden, writing with reference to his letter of the

15th of March, gave the same account of great appearance followed by disappearance. He observed:—"At that time I was receiving grievous letters of complaint. One I had from Mr. Granger, of Ely (a large grower and jam manufacturer), in which he says, 'My Gooseberry-buds are quite red with the Spider'; and others of a similar nature. . . . Since then we have had showery weather, and I am pleased to say that quite three-fourths of Spiders have disappeared. Whether it may be that they have only gone down into the soil to reappear at a more favourable season, I am unable to say; but the fact remains that at the present moment there are many bushes on which I can find *none*, and where I can find them they are in the *centre* of the bush *nearest* to the ground. There are positively *none* on the outside branches."

A few other observations were sent me, but nothing like the report of damage sent in the two previous years; and nothing was added to methods of prevention and remedy, excepting still further proof of the absolute necessity of applying such of these as we know act reliably on the *very first appearance* of Red Spider in late winter or early spring.

On the 29th of April Mr. Nixon (before mentioned, who has observed and reported this attack to me regularly from its first bad outburst in 1893) mentioned, in sending me some specimens I had asked for, that these were not from his own grounds, as he was glad to say he had positively none; he had finished syringing for the second time about three weeks before, and since then he had scarcely been able to find a single live Spider, and to find one at all required looking over many bushes. "My bushes are practically cleared; it is the best result I have ever attained, and I attribute it solely to the fact of my commencing to syringe *as early as possible when the Spiders were only just hatched, and no foliage to shelter them.*"—(F. N.)

Quite absolute certainty as to what distinct species of the Gooseberry Red Spider (scientifically, *Bryobia*) may be present, is a point which none but skilled experts can decide; and resting on this we appear to have two species present, one of these being, as mentioned in my two preceding Reports, the *B. prætiosa*, of C. L. Koch, as kindly identified for me by the skilled determination of Mr. Albert Michael, F.L.S.* The other proves, from the investigation of Dr. F. Thomas, of Ohrdruf, during 1894 and 1895, to be a species hitherto undescribed, which he has named *B. ribis*. For those who wish to go into the subject fully in minute detail, with the points of distinction between the above and various other species, the information will be found in the paper mentioned below.†

* See my 'Seventeenth Report on Injurious Insects,' page 33.

† 'Die rote Stachelbeer Milbe, *Bryobia nobilis*, C. L. Koch (?), ein in Deutschland bisher nicht beachter Schädiger des Stachelbeerstrauches,' von Prof. Dr. F. Thomas in Ohrdruf (aus Wittmack's 'Gartenflora,' 43. Jahrgang, 1894).

But looking at some of the points, which can be seen with the help of a moderate magnifier, and are serviceable to know for practical work, a very important one is that the Gooseberry Red Spiders, that is, the species of *Bryobia*, are clearly distinguishable, by their foremost pair of legs being *much longer* than the others, from the Hop Red Spider, *Tetranychus telarius*. The life-history is that they are hatched from eggs, and at first have only three pairs of legs; with increase of age they develop another pair, so that in adult state they are eight-legged (see figure, p. 40). The colour in the specimens sent me was brick-red of various shades, from bright to ordinary brick colour, and in some instances I have found them of a vermilion colour along the back of the abdomen, and much darker at the sides. The length was about the thirty-second part of an inch, that is, about a quarter of an eighth of an inch.

So far as I am aware, our infestation (so to call it) resembles in all points of its life-history and means of prevention of its ravages the species, very fully described with all points considered, in the paper on the 'Red Gooseberry Mite' ('Die rote Stachelbeer Milbe') previously cited, and here also the points of distinction between the above species of *Bryobia* and other very similar kinds, turning much on numbers of pairs of scales (Schuppen) on the back or elsewhere, will be found at pp. 493—495.

But for practical purposes for ordinary observers the following short report given by Dr. F. Thomas at Mülhausen, in Thuringia, later on in 1894, will be found to contain plain and useful information.* In this Dr. Thomas spoke on the injury to Gooseberry-bushes caused by *B. ribis*, n. sp., a small red-brown mite of about two-thirds of a millimetre in the length of the body, and demonstrated the extent of these injuries by specimens which he had taken just before the meeting from a garden in Mülhausen. These specimens had become whitish on the upper side from the suction of the mites, and the small remaining leaves had not power to provide a sufficiency of nourishment; the fruit dropped prematurely, and so did the leaves in autumn.

"The mites live from March and April until the beginning or middle of June, and in the early part of the spring may be successfully combated by plentiful sprinklings of the Gooseberry-bushes with water, or occasionally with weak soap-wash.

"In May and June the mites lay small shining red eggs, which are plainly observable, with the help of a weak magnifying-glass, on the twigs, and especially on, and between, the remains of the old bud-

* 'Aus dem Sitzungs-Bericht, der Frühjahrs Hauptversammlung 1894 (zu Mülhausen, in Thüringen). Sonderabdruck aus Mittheilungen des Thür. Bot. Vereins,' Neue Folge, Heft vi. 1894, Seite 10 u. 11. For both his detailed paper and this leaflet I am indebted to the kind courtesy of Dr. F. Thomas.—Ed.

scales. These eggs remain unchanged during the remainder of the year, and it is not until the following spring that the young mites escape from them. With regard to methods of prevention by killing the eggs, no information has been brought forward.

"Of the hitherto described species of *Bryobia*, the Gooseberry Mite, the *B. nobilis* of C. L. Koch, comes the nearest; however, according to Koch's drawing and description, characteristic differences are present which clearly permit venturing identification of two species.

"As hitherto no notice has been given of this increasing, and in dry years very dangerous, enemy of Gooseberry-growing, in German serials, or books of instruction, or in statements in known literature, the report in Wittmack's 'Gartenflora' of the year 1894, containing a fully detailed communication on the subject with figure accompanying, was published."—(F. T.)* To this Dr. Thomas adds a few lines relatively to my having contemporaneously brought forward in my own Annual Report considerations regarding the injurious infestation of Gooseberry Red Spider in England.

As the matter stands at present, it appears to me that we have two, and possibly more kinds of what, for all practical purposes, it is enough for us to know as Red Spider on Gooseberry-bushes, and that these kinds are so similar in their habits, that they lie under the same means of preventive treatment.

Of the applications most serviceable for this purpose, all observations (that I am acquainted with) agree in stating that washings with a basis of soft-soap are most useful. The "Kerosine Emulsion," so much thought of in the U.S.A. (especially if used warm), is an excellent application, and what may be called its "British representative," the "Anti-pest," manufactured by Messrs. Morris, Little & Son, of Doncaster, is very widely used, and with great success, and is to be recommended for use by all those who have not acquired the difficult knack to master, of so blending the soap and mineral oil of the Kerosine Emulsion that they shall not again separate. I also believe that a composition with a basis of soft-soap, brought out by Messrs. Stott under the trade-name of "Kill'mright," has been found serviceable.

Dry dressings, such as soot, or slacked lime, have been reported to me as useless, as also application of paraffin oil much diluted, but without soap added.

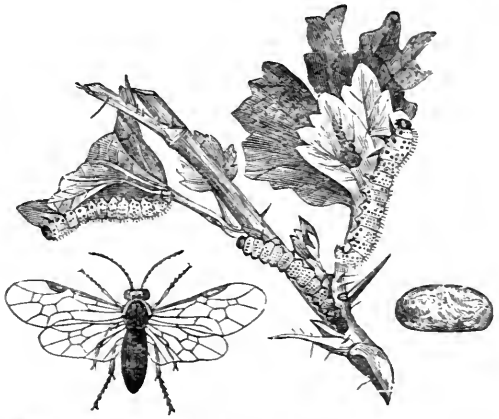
Where very plentiful washings with water alone can be given, these are serviceable, because, as pointed out in Dr. Friedrich Thomas's paper before referred to, this partly stupefies the mites,—causes a lethargic condition from which, if soon dried, they recover, but in which, if continued for some days, they waste.

* See paper by Dr. Thomas, from whose short leaflet on the same subject I have translated the above, of which the title is previously given.

The fact of the eggs being found in the crannies of rough bark during winter, and of the mites similarly sheltering during the season of their fully-developed presence, points directly to the advantage of scraping off and getting rid of rough bark as far as can be managed, and also of removing gnarled and rough-barked boughs; also, and very particularly, of syringing and running soft-soap washes down the stems so as to fill the crannies and angles of the branches, and thus choke up the lurking-places, and stifle the mites within them.

To the above should be added a note of the vital importance, if the infestation is to be got rid of, of commencing remedial operations *as soon as ever* it appears in the spring. If a little keg of whatever mixture the owner prefers is kept at hand on grounds where there is reason to suppose the attack may appear, then at the *first signs* (it may even be as early as the middle of February) the remedy can be applied forthwith, and it may be hoped a cure made. But if instead advice has to be sought, and the application to be written for, days are lost, in which the injurious pest is hatching out by hundreds or thousands, and not only doing present mischief, but establishing itself to lay the foundation of further presence.

Gooseberry and Currant Sawfly. *Nematus ribesii*, Curtis.



NEMATUS RIBESII.—Male Sawfly, caterpillars, and cocoon, all much magnified. After figures in Reports of Ent. Soc. of Ontario. Dimensions given in letterpress.

Gooseberry Sawfly needs some reference again for several reasons, one of these being the great amount, and also the destructive nature of its attacks in various places, notwithstanding the severe cold of the latter part of the winter. With some of our injurious insects it may be difficult to be certain whether or not especially great cold reached

them; but, in the case of the Gooseberry Sawfly, the position of their winter caterpillar-cocoons, just below the surface, gives a very fair example of non-injury from severe cold so long as the creatures are in their own self-arranged shelters.

Often also there is such difference in temperature at different localities that it is difficult to make sure of coincidence of special conditions of weather and of insect presence. But last winter the severe cold was general, and without going into readings of earth temperatures at different depths below the surface, we get good practical guidance to the long frost-bound state of the ground in the returns of various of the leading agricultural papers at the end of February and beginning of March as to the land in the various wide districts named being only then beginning to get into order for ploughing.

Also, in the past season's reports, we have mention of success of some good broadscale remedial applications, and, on the contrary, of failure of treatment, for which possibly there might be a cause.

Also, from enquiry sent to myself, some further allusion seems requisite to the change that takes place in the appearance of the caterpillars at their last moult. This is not as great as in the case of the Pear-tree Sawfly, in which the black, slimy, slug-like grub, on casting its skin, appears as a dry orange-coloured caterpillar; but with the Gooseberry caterpillar, the casting of the green and yellow black-spotted skin, and assuming one of unspotted green and yellow, gives such a different appearance to the grub as sometimes to cause doubt how many kinds are present.

One of the first reports of bad amount of presence of Gooseberry Sawfly caterpillars was sent me from Stratford-on-Avon, on May 10th, by Mr. Wilson, as follows:—"I have a plantation of Gooseberry-bushes, and last year they were very badly infested with caterpillar. I had two men on for a fortnight hand-picking them, but could not keep them under, and most of the bushes were stripped. I was through them this morning, and am sorry to say I found quite a number of the insects all through the plants, but as yet there is no serious damage done, and as the attack is much earlier this year than last, I hope to be able to clear them by spraying."

On the 13th of May Mr. Wilson further noted that the caterpillars had made great havoc since the date of his first letter, and that he was then starting hand-picking.

The following report of presence of Sawfly was sent me on the 15th of May by Mr. Edwin Ellis, from Summersbury, Shalford, near Guildford. This, it will be seen, notes devastating amount of attack on the large area of sixty acres of Gooseberry-bushes, this following on slight presence late in the previous year, after nine years' previously observed immunity from attack; also the failure of remedial measures:—"I

have sixty acres of Gooseberries attacked by the Sawfly caterpillars, from which they have for nine years been perfectly free, with the exception of last year, when a few appeared in September after the crop was picked.

"The ravages committed within the past three days are perfectly astounding, despite the fact that every available hand has been put on spraying with quassia and soft-soap, while others follow and spread slacked quick-lime on the creatures as they lie under the trees. We are picking the fruit as fast as possible where we have *not* used the spray; but with such a big ground there appears little hope of stopping the mischief."

Mr. Ellis further enquired whether there were any means by which the pest could be got rid of for the future, as it was ruinous if continued, and he could hardly hope that all would be exterminated by any system whatever. This matter I refer to further on.

On the 24th of May Mr. Eldred Walker, writing from White Hall Farm, Chewstoke, near Bristol, gave me the following recipe for a good broadscale application which he had found useful in clearing this destructive pest:—"It may be of interest to you to know how I have exterminated the Gooseberry Sawfly and Red Spider from my garden. For several years my Gooseberries were completely spoiled by these pests. I made a couple of hogsheads of strong lime-water, and thoroughly sprayed the bushes with it *early in the morning*.* I had an assistant to pull the bushes over, so that the liquid might reach the under part of the leaves as well as the outside. After about five minutes of this, I had the bushes violently shaken, when nearly every insect dropped off; to complete their discomfiture, directly I had done shaking the bush, I had the surface of the ground freely dusted with air-slaked lime. I had this done three times at intervals of two days, and now I have not the slightest trace of the ravages of either in my garden. I find this treatment is far better in the early morning than when it is used at mid-day."—(E. W.)

The following observation, sent me on the 10th of July by Mr. Geo. Whereat, from Aldington Grove, Sydenham, shows continuance of bad attack late in the season, and in this case notes it also as infesting the Currant-leafage:—"I am suffering from a regular epidemic of caterpillars on the Gooseberry-bushes. . . . These are eating every leaf off the bushes. I have tried soft-soap and paraffin, which they seem to thrive on, also salt water; hand-picking seems useless, as there are frequently four or five on each leaf,—I found seventeen on one Currant-leaf. They are very pale transparent green, with tiny black spots, a yellow band at head and tail, varying in size from about a quarter-inch to an inch in length."

* I add the italics, as this is a very important point.—Ed.

Various other communications were sent me, unnecessary to enter on at length, including information on the 21st of May of great numbers of Gooseberry Sawfly caterpillars being observed near Crocken Hill, Swanley, Kent; and on the same day it was reported from Billinghurst, Sussex, that they were "fearfully troubled by the Gooseberry caterpillar in that district."

London-purple as an insecticide.—The following detailed notes of method of (and also success of) application of London-purple for getting rid of the Sawfly caterpillars are well worth attention, not only as a cheap and simple method of getting rid of this special pest, but also because, if properly used, it is as serviceable for use as an insecticide as the better known Paris-green. Both of the chemicals are poisonous. The Paris-green is an *aceto*-arsenite of copper, the London-purple is an arsenite of lime; both therefore require care in use, as has been specified before.

The great difficulty in the first use of London-purple was that in the U.S.A. (from whence, as well as in the case of Paris-green, we first learnt its value) it was thrown out as a waste product of such various strength that nothing but special trial of extent to which it might need diluting made its use safe. Here, however, we can procure analysis which saves successive trials. I have at this minute that of Messrs. Hemingway, of Mark Lane, London, E.C., before me.

The following note was sent me on May 10th by Mr. F. Nixon, from Great Eversden, near Cambridge:—"With regard to the London-purple, I have used it for the last five to six years, and at the outset made sad havoc amongst my trees and foliage, in fact I killed numbers of trees by giving too strong an application. I am wiser now, and have found out the proper proportions in which to mix it. Nothing appears to me so good, cheap, or easy of application. I use Hemingway's, and mix in the proportions of 1 lb. of purple to 200 gallons of water. The purple itself should be mixed to the consistency of paste before finally mixing with the bulk of water, and this bulk must be well stirred *every time* the spraying-machine is filled, otherwise the purple will be all at the bottom, and the water at the top, the effect of which is that in some places the caterpillars are not killed, and in others the foliage is scorched (I am speaking of Gooseberry-bushes).

"Our No. 86 spraying-machine (the one I am interested in), manufactured by Messrs. Boulton & Paul, of Norwich, is an excellent implement for spraying this insecticide for the reasons that for this purpose I have a return-pipe attached to the pump, so that a strong jet of the mixture is continually forced through the bulk which the tank of machine contains, thus keeping the whole, as it were, boiling and well mixed up.

"The caterpillars *are not killed the same day* the application is made.

The day after some will be found dead; the second day, a good number; and the third day, as a rule, the bushes will be cleared. Many people make a grave error here. They expect the insects to be killed in a few hours after the application, forgetting that they must have time to eat the poisoned foliage, and that it must have time to do its work. Consequently they will apply a stronger mixture, which is certain to scorch the foliage, and thus they complain that purple can only be effective at such a strength as will likewise burn the foliage. This is entirely wrong, for after years of experience I can confidently guarantee that, mixed and used in the proportions and way I have named, London-purple will kill almost every caterpillar that may be present. I am proving this every day in my own orchards."—(F. N.)

To the above, Mr. Nixon added that he sent me a few Gooseberry-leaves with the caterpillars on them, as he wished me to see exactly how they died. These had been syringed with London-purple in the way described above at noon on the previous day (that is, just twenty-four hours from time of writing). Mr. Nixon noted that they were not quite dead when he put them into the box, but supposed they would be when they reached me, which proved to be the case; all the specimens—that is, the caterpillars of the Gooseberry Sawfly—were dead when I received them on the following day.

The Gooseberry Sawfly caterpillars, when full-grown, are about an inch in length; the ground colour green or pale-green; the segment next to the head and a little of the next one orange-coloured; so also are the tail segments, but with such a large black mark above, with smaller dots at the side, that the tail is sometimes described as black. They are furnished with a pair of black claw-feet on each of the three segments next the head; the next segment is legless; and on the succeeding six segments is a pair of pale-coloured sucker-feet, and there is another pair beneath the tail, making twenty pairs in all. The caterpillar is sprinkled with dots, or patches of black, until its last moult, when these are thrown off with the skin, and the caterpillar becomes of a pale-green, but still orange behind the head and on the tail.

Shortly after this last moult they go down to the ground and bury themselves, and spin their cocoons, about two inches deep, or more, according to the nature of the soil, and in these they turn to chrysalids.

The Sawflies come out from these cocoons in about three weeks in summer; the late broods of caterpillars remain in cocoon during winter, and the fly comes out in the following spring at the time of the Gooseberry- and Currant-bushes coming into leafage. The Sawflies are of the shape figured at page 45, with four transparent wings. The head and body between the wings are yellow or ochrey, marked

with black; abdomen yellow or orange, more or less marked above with black. The expanse of wings half to two thirds of an inch.

Prevention and Remedy.—The fact of the cocoons, from which the Sawflies come out, being formed *in the ground, just below the surface, beneath the bushes,* on which the caterpillars fed, is the basis of all reliable methods of prevention of recurrence of attack.

It is obvious that if the surface of the ground containing these cocoons is skimmed off and destroyed, this cannot fail to lessen the amount of Sawflies which would have hatched from them. But for this, it is necessary that the cocoons should be destroyed, and if they are skimmed off this can be done; but digging them in is an exceedingly doubtful preventive.

It is a practice sometimes to scrape the surface-earth from beneath the Gooseberry-bushes in the autumn, and to form it in a line between the rows, and there dig it in, and doubtless some amount of attack is got rid of in this way; but for the plan to be at all trustworthy, the earth should be *trenched* in, so that the infested earth should be put thoroughly down at a depth from which the Sawflies (if they developed at all) could not come up in spring.

Sometimes, however, the scraped-off earth is left (as I have seen it myself) lying in lines between the Gooseberry-bushes without anything further being done to it, and the result was, as might have been expected, the cocoons lay uninjured through the winter, and as the grounds were large, the mischief that followed in spring was to a serious extent.

At a time when I had attack in my own garden, I found that it answered to completely remove the soil for a few inches deep in autumn from beneath the infested bushes, and dress with manure; and the following note, sent me some years ago by Mr. Alex. Anderson, from The Gardens, Oxenford Castle, Dalkeith, N.B., is well worth attention:—"For twenty years Gooseberry Sawfly caterpillars have not occurred in the gardens under treatment in any quantity. The surface-soil under the bushes is annually removed in winter, a deep hole is dug in one of the quarters, and in this the removed soil, with *whatever may be in it,* is buried. The soil under the Gooseberry-bushes is replaced by that out of the hole, with the addition of some manure." —(A. A.)

The above is only one of various reports given by superintendent gardeners as to the thorough success of *removal* of the infestation bodily.

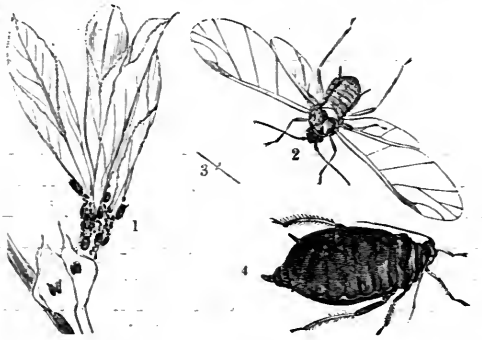
As a lesser measure, dressing with lime, or, better still, with gas-lime, in early spring under the bushes before pricking the surface, has been found very beneficial. The sprinkling of gas-lime must of course be given with caution as to amount.

For dressings to the leaves when attack is present, sulphur, *dusted on the leaves when the dew is on*, has been found to act well; also a liberal sprinkling of soot *early in the morning when the leaves are damp* has answered well. Hellebore powder is a good remedy so far as clearing the caterpillars is concerned, but being a poison should only be used by those who can be absolutely sure there is no risk of the powder remaining on the berries when gathered for use. Hot lime also, dusted on the leaves, does good; and other ordinary insecticides, wet and dry, which have previously been specified, and which will occur, indeed, without specification to all fruit-growers.

But, from the numerous letters sent me in the past season, there appear to be a few leading points in prevention and remedy that need to be much more attended to. *Clearing the cocoons out bodily* from under infested bushes is of the greatest importance; also that powder dressings should be thrown so as *to adhere*, that is, when the leafage is damp; and also sufficient attention is not paid to the lime being *used hot*.

MANGOLDS.

Black Aphis; Collier. *Aphis rumicis*, Linn.



APHIS RUMICIS.—1, infested Bean-shoot; 2 and 3, male, nat. size and magnified; 4, female.

In the earlier days of Mangold-growing in this country, this crop was considered to be remarkable for its freedom from insect attacks. Whether this was the case, or whether it was simply that the infestations were not observed, is doubtful, but during the past few years several infestations have shown themselves which had been little, if at

all, observed before in connection with Mangolds here. Last summer, besides the almost regular yearly attack of Leaf-blister Maggot, we had a bad infestation of the Black Aphis, the *Aphis rumicis*, commonly known as "Colliers" (and as a crop-pest chiefly infesting Bean-shoots), on Mangold-leafage near Llandudno, in North Wales; also the *Silpha opaca*, or Beet Carrion Beetle, a rare attack, but sometimes exceedingly destructive where it does occur; and the *Atomaria linearis*, called, from its minute size, the Pigmy Mangold Beetle (also rare, and also very destructive from the myriads in which it occasionally ravages at the young Mangolds), were again observed.

So far as I am aware, the above-mentioned kind of Black Aphis, the *A. rumicis* scientifically, although in the words of Mr. G. B. Buckton it is "almost omnivorous," has not been previously trustworthily identified as a Mangold infestation. In 1885, when Aphis-attack was one of the chief crop troubles of the year, there was uneasiness, both in England and Ireland, lest the quantity of Black Aphides on the Mangolds should prove to be the Colliers, the well-known pest to the tops of growing Beans. This, however (speaking, of course, only of the samples of attack sent to me for examination), I could quite certainly say they were not; but during the past summer I received a note of the appearance of this attack (that is, of Colliers) on Mangolds in one locality from Mr. Robert Newstead, Curator of the Grosvenor Museum, Chester.

On August 9th Mr. Newstead forwarded me specimens of Mangold-leaves infested by quantities of what proved on examination to be Colliers in different stages, with the following information:—"The leaves of Mangold I sent by this morning's post are infested with *A. rumicis*, Linn., and as I never heard of the species infesting Mangolds, I thought you would be interested to have specimens."

Mr. Newstead wrote me that the attack was a very bad one, and the locality of the outbreak was near Llandudno (in North Wales, at the mouth of the Conway), and further, that if I wanted more specimens he had "an enormous quantity of infested leaves." These, however, were quite unnecessary, for the quantity of Aphides forwarded appeared to me to leave little if any doubt of the attack being that of *A. rumicis*. The following description, chiefly taken from that of Mr. G. B. Buckton,* gives some of the chief characteristics by which this kind of Aphis may be distinguished from other black, or chiefly black kinds which are to be found on Mangolds or allied plants.

Aphis rumicis: Wingless viviparous female. — Head, thorax, and abdomen almost confluent. This massing together of the chief divisions of the body is well shown in figure 4, p. 51, of the wingless

* See 'British Aphides,' by G. B. Buckton, F.R.S. (Ray Society), vol. ii.

female, magnified. Eyes black; body wholly black; cornicles (honey-tubes) and tail black.

Winged viviparous female.—Wholly black customarily, but occasionally of a slightly rusty-brown, and when changing from the pupal state brown, with honey-tubes and horns green, soon, however, gradually changing in tint to shining black; wings short and coarse, with fore-edge and patch on it greenish, other veins brown.

Egg-producing female.—Very like the above-mentioned wingless form.

Male.—Black and winged.

Young.—Slaty-grey, afterwards with "a blackish velvet-like coat."

Pupa.—Head and fore body slaty-grey, with the wing-cases black. "Abdomen black, with four strongly-marked white downy spots ranged on each side, followed by a break near the insertion of the cornicles. Two small white patches occur on each side near the tail, and also an exterior row of dots on each lateral edge. These squarish markings give the insect a kind of chess-board or chequered appearance."—(G. B. B., *loc. cit.*)

The two other kinds, which so greatly resemble the above that they may very possibly be confused with it, are *A. papaveris*, Fab., and *A. atriplicis*, Linn. The first of these is known to frequent Mangolds; the second is to be found on *Orache* and other plants of the same order as that to which the Beet or Mangold belongs. Both these kinds are stated to have the *pupæ* (that is, the stage in which the insect, if winged when perfect, bears wing-cases) spotted with white. But in the "*papaveris*" the females are more of an olive-green tint; and the "abdomen of the winged viviparous female is olive-green, with three or more dark lateral spots on each side, and several obscure transverse bands." In the case of the "*atriplicis*," the winged viviparous female has the body of a dark olive, and the "abdomen very large, obscurely barred with black, sides spotted."

Where the insects in all their stages are submitted for examination, and are typical in their markings, they may be pretty surely identified, and in addition to the definite statement of Mr. Newstead (who is perfectly qualified to give a trustworthy identification) as to the infestation at Llandudno being of the *A. rumicis*, it appeared to me to be so; still, the differences between the three species above-named are so very much involved, that it is difficult to speak with quite absolute certainty.

Amongst the various observations of Mangold-attack sent me, none of the others appeared referable to presence of *A. rumicis;* but by favour of the Editor of the 'Agricultural Gazette' I received, on Aug. 9th, specimens of such an utterly overwhelming attack of mixed nature, including Aphis infestation as the chief part of it, that I give

my description as printed in the 'Agricultural Gazette' of Aug. 12th, at p. 155:—

"Your correspondent's Mangold-leaves show a most seveve attack of Aphides, commonly known as 'Plant-lice.' I have seldom seen Mangold-leafage so coated with cast skins, dirt, and mould or fungus. But in the specimens sent me the insect attack, from its very intensity, appears to be killing itself out; there are myriads of cast skins, but I find very few live Aphides, and from the way in which the old skins are massed together with mould, the presence of other fungi, and the discoloured and sickly appearance of various of the live Aphides which are to be seen, I should hope that they were infected, and were being killed by the mould.

"But with regard to remedy, I do not see that any dressing can be applied to clear the leaves. Even in a bowl of water, and after soaking, it takes some rubbing with the finger and thumb to clean the leafage even moderately. On getting the dirt off, I find brown patches, which may have very likely been originally caused by the Mangold-leaf Maggot burrowing between the two sides of the leaf; but in the present condition the patches show only as destroyed portions."

The contributor of the specimens had mentioned that he had sown 1 cwt. of nitrate of soda per acre over them with no effect; and regarding this I suggested:—

"Probably nitrate of soda is the very best of all applications, for it will keep up the growth of the plants under attack if anything will; but I would suggest clearing away coated leaves, lest the fungus of other kinds besides the filmy growths (commonly known as mould) should spread to the sound leafage.

"Mangolds have such great power of 'recuperation,' so to say, struggling up to a good paying crop where even a small centre, *if* healthy, is left (after the cause of evil is removed), that I would certainly suggest to your correspondent that any application to drive on growth would be the best form of treatment; and of such applications, guano, soot, and also mineral superphosphate, have all been found to do good, especially the last-named. But nitrate of soda stands, so far as I know, quite at the head for efficiency."—(E. A. O.)

In these kinds of infestations there seem only three ways of dealing with the matter,—one that of killing the Aphides; but, though this can be managed by use of soft-soap mixtures, as in Hop-washing, or on Aphis-infested fruit-trees, it appears next to impossible to bring the plan to bear in the case of large-leaved field-crops like Mangolds or Turnips.

Another point which deserves very attentive consideration is checking increase of attack by destroying, as far as can safely be done, the infested leafage. Where the leaves, as in the attack mentioned

above, have ceased to be useful, there is no reason against removing them, with a good hope that if the centre is still healthy the plant may be saved. The power of making a fresh start when growth is well pushed forward by stimulating manure is excellently shown by the following observation of successful treatment of badly attacked Mangolds at Rothamsted in 1890, which I was favoured with by Mr. J. J. Willis, by kind permission of Sir John Lawes.* In this instance the damage to the leafage was from Leaf Maggot, but the power of recovery of the plant would be the same whether outer leaves were destroyed by the Leaf Maggot within them, or Aphides sucking their juices, or Beet Carrion Beetle clearing off the leafage bodily down to the centre.

The Rothamsted observation was as follows:—"*Insect injury*, 1890.—A field of Yellow Globe Mangolds of fourteen acres on the farm of Sir J. B. Lawes, at Rothamsted, was badly attacked by the Mangold-leaf Maggot (*Anthomyia betæ*). The field was manured with twenty tons per acre of farmyard dung, applied just previous to sowing the seed. The injury commenced in July, and gradually got worse, until the leaves of the whole crop had the appearance of being scalded. They were of a brown colour, and greatly shrivelled up.

"In the first week of August an application of 2 cwt. of nitrate of soda per acre was sown broadcast over the whole field. The injured leaves soon died off, and the plants formed new growth. The crop was taken up towards the end of October, and gave an average produce of almost eighteen tons of roots to the acre."—(J. J. W.)

The above is a first-rate example of the well-known power of the Mangold to recover itself from effects of attack under favourable circumstances, and when the cause of evil has ceased of itself, or been removed. Also it shows the prudence of the rule laid down, not to be over-hasty to plough in a much damaged Mangold-crop.

But whilst we all know the importance of a proper amount of strong healthy leafage for formation of good roots, it is an open question whether we should not benefit very much in lessening insect infestations at a small quantity (if any) of loss to size of roots by removal of *superfluous* leaves. This is independent of cutting off leaves which are badly infested, which it is obvious is desirable when they are doing little excepting acting as a nursery for pests.

But if we look back to the early days of Mangold-growing in England,† when the gold medal of the Society of Arts, &c., was awarded to Leonard Phillips for his successful work in the introduction

* See my 'Report on Injurious Insects for 1890.'—Ed.

† See 'Farmers' Journal and Agricultural Advertiser' for April 8th, 1816, of which Journal (the precursor of our 'Bell's Weekly Messenger') a series was kindly placed in my hands for reference.

of this root, it will be found that very much more was then customary in the way of taking a portion of the leafage for fodder than is now done; and taking data at the two ends of special record, before the custom fell into disuse, we have roots raised in November, 1816, after six successive strippings of leaves, giving a weight of 20 lb. each and upwards; and in 1860, the special experiment at the Model Farm, Glasnevin, when of two lots of Mangolds grown precisely similarly in every respect, excepting removal of leafage, the plot from which 5 tons of leafage per acre had been stripped gave a return of 45 tons 1 cwt. per acre, whilst of those from which no leafage had been taken the return was 40 tons 8 cwt. 6 qrs. per acre.*

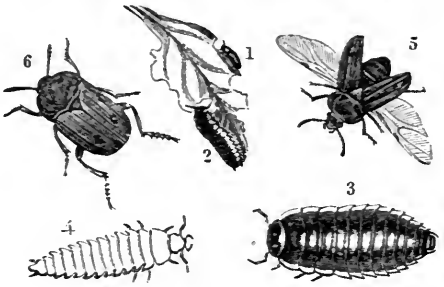
No doubt, to quote Prof. Wilson when writing on this point, *the practice is quite opposed to our knowledge of vegetable physiology*, but it is worth serious consideration that it was not until a few years after the custom of some amount of leaf being removed had fallen into disuse that trouble began about Mangold-leaf Maggot, this increasing until, about 1876, it appeared as a really severe attack, and now as a yearly trouble. Also, instead of Mangolds being now a crop remarkable for freedom from insect ravage, the list of its infestations would rank with those of almost any of our field-crops.

It would be unreasonable to advocate removal of healthy good leafage; but a middle course between stripping for fodder and letting the whole of the old outer leaves remain when they have got to the stage of often overshadowing each other, and their own serviceableness being lessened by age, injury of different kinds, and decay, appears worth consideration.

The third important point as a remedial agent is any application to push on good growth; and connected with this, as a preventive, the thorough cultivation beforehand, which will push on growth, and be returned well as to cost if no attack comes; and if it does, will give the crop a good chance of growing past it.

* For details, see quotations in Appendix to my 'Sixteenth Report on Injurious Insects.'

Beet Carrion Beetle. *Silpha opaca*, Linn.



SILPHA OPACA.—1–4, larvæ, nat. size and magnified; 5, 6, beetles, magnified, natural length about five lines.

Beet Carrion Beetle is an attack which is seldom noticed, but which is exceedingly destructive at times to young Mangolds; and in the past season I was favoured with the following note of its persistent recurrence for the past few years to a slight extent, and its very bad attack in the past season on ground at Batworthy, Chagford, near Newton Abbot, Devonshire, by Mr. F. N. Budd:—"You may remember that four years ago I reported to you an outbreak of the larvæ of the Carrion Beetle in my Mangold-crop at Batworthy, a small farm on Dartmoor, a few miles from Chagford. You gave an account of the occurrence in your Report for the year 1891, of which you kindly sent me a copy.

"My Mangolds have suffered slightly from the larvæ every year since, but this year the crop (luckily a small one) has been almost entirely destroyed by them. I am sorry that, not being in residence, I have been unable to make any careful observations; but a visit to Batworthy a few days ago showed me the crop nearly destroyed, and the larvæ present in great numbers."—(F. N. B.)

These larvæ, or grubs, are black (so that they are not always recognized as being really grubs); they grow to as much as five-eighths or nearly three-quarters of an inch in length, and much resemble in shape the creature known as a Wood-louse. There is, however, some variety both in shape and colour. Occasionally the grubs have a narrow tawny-coloured edge, and sometimes, as shown at figure 3, they have the exact Wood-louse-like shape; sometimes they are narrower, as shown at figure 4 (in outline), and it is this shape which I have most frequently received. The rounded edge of the three segments behind the head, and the sharp edges of the succeeding segments, giving a saw-like appearance to the sides of the grub, are characteristic.

The method of attack was found by Mr. D. Sym Scott, of Ballina-

courte, Tipperary, Ireland, in his observations, sent me in 1888, to be feeding mostly during the evening and early morning when the leafage is moist, taking the young leaves first and eating them down to the soil. When these were finished, the maggots attacked the tender root, sometimes gnawing it off for about a quarter of an inch below the surface of the soil. The attack, judging by the various observations sent, lasts from early in June until towards the end of July. When full-fed, the grubs go down about three or four inches deep into the soil, and there change to chrysalids; and if undisturbed the new presence of beetles from these chrysalids may be expected about three weeks after the disappearance of the maggots.

The beetles average five lines in length, flattish, brown-black, and slightly downy, and have three raised lines along each wing-case (see figures 5, 6, p. 57), and are to be found during winter sheltering under clods or stones, or in moss or rotten wood, and, later on in the year, are to be found in dead animals. From this double nature of food they take their double name of Beet Carrion Beetles; and in grub-state, although I have never absolutely seen them feeding on putrid meat, specimens under observation to which I gave nothing but meat gradually becoming putrid for food, remained for so many days lively and hearty, that it was presumable they fed upon it.

This attack does not seem to be increasing, for in 1888, the first year (so far as I am aware) of it being observed as a crop-pest in England, a few observations were sent of it doing mischief at localities widely apart, and of greater amount of its presence in Ireland. In 1891, the second year in which I had observations of it in England, it was only reported from one locality, namely, from Batworthy, in Devonshire (mentioned above), and now again in the past season the only reports sent of its reappearance are its bad attack at that locality; and also I have information from Mr. D. D. Gibb, of Ossemsley Manor Farm, Lymington, Hants, of it being present there also.

No new information has been given as to methods of prevention; but where crops are destroyed so that the ground is cleared, it should be remembered that just then (for about three weeks after the disappearance of the maggots) they are going through their changes to the beetle-state only about three inches below the surface, and cultivation that will break open the soil just to the depth at which they are lying will in various ways much lessen their numbers, and especially if quick-lime, or a light dressing of gas-lime, is thrown. If circumstances allow of the land being left clear for a month, probably a dressing of two tons per acre, the amount considered quite safe under the above circumstances by the late Dr. Aug. Voelcker, would do a great deal towards clearing the infestation. Also with this attack, when it is a question of ploughing in the young Mangolds on account of severe

injury *then going on*, it would be desirable to collect some of the grubs in order to ascertain whether they are nearly full-grown. If they are between half an inch and three-quarters in length the attack is almost certainly nearly over, and if there are still centres of leafage remaining to the roots, and conditions of ground and weather are favourable for growth, it may quite be hoped that the plant will recover. The grubs should be looked for at night, that is, as late in the evening, or early in the morning, as may be conveniently practicable, or, if this cannot be done, by searching in the ground round the attacked plants they would be almost certain to be found.

I am not aware of the effect of deterrent dressings having been tried, but it would be well worth while to see whether soot and lime, well mixed, and liberally scattered over the plants in the evening when the grubs are coming up to feed, would not have a good effect. The well-known mixture of quick-lime and gas-lime, about one bushel of each, and soot and sulphur in lesser quantities, all powdered up fine and mixed well together, and applied in the evening *when the dew is on*, could hardly fail to do good.

Early sowings have the best chance of escape because the plants have got to some degree in advance of growth before they have to bear the brunt of the attack, and all measures that give a hearty growth are of course important. But where this attack occurs, and the ground can be spared for a few weeks, it would appear that the best treatment of all would be to lightly stir the surface of the soil when the maggots are changing to chrysalids, and at the same time to give as strong a dose of fresh gas-lime as a dressing as may be judged safe, and thus it might be hoped stamp out the trouble.

Pigmy Mangold Beetle. *Atomaria linearis*, Stephens.

ATOMARIA LINEARIS (after Taschenberg).—Natural length one twenty-fourth of an inch.

The attack of the Pigmy Mangold Beetle is probably the cause of a great deal more mischief than is generally known. From its exceedingly small size—for it is only about half a line, that is, one twenty-fourth of an inch, in length—it escapes observation, unless noticeable from the enormous numbers in which, where there is serious attack, its presence occurs. But even then, as its attack is to a great extent

below ground, this causes the myriads in which it appears to be sometimes confused with a visitation of Red Ants. The exceeding minuteness of this Pigmy Beetle makes it almost impossible to show even its length and breadth in a figure of natural size, and in farm-work it would be quite impossible to distinguish it accurately without the help of a strong hand-magnifier.

When so examined, it will be found to be of the shape figured (much magnified) at p. 59, that is, long and narrow; it is slightly flattened above, and downy, and in colour varying from rusty-red to brownish-black. The horns, or antennæ, are slender, terminated by a three-jointed club, and chestnut-coloured; feet also chestnut-coloured. Wings ample.

The mischief is done by the beetle first attacking the root (first of all the tap-root) of the young Beet or Mangold. This occurs early in the season. In 1892 the late Prof. Harker wrote to me, on the 27th of February, from the Royal Agricultural College, Cirencester:—"I think I mentioned to you that I found myriads of a small *Atomaria* at our Mangolds last spring, when we lost about half the crop." With this, Prof. Harker forwarded me various extracts on the subject of the attack of the *Atomaria linearis*, first observed in the year 1839 by Armand Bazin, of which he observed that they most accurately described the appearance of the attacked Mangolds, and that he "could have collected hundreds of *Atomarias* at each plant." Also Prof. Harker remarked that he had not thought previously that they were such severe pests.

From collating the accounts of various Continental writers, it appears that even by the middle of June the beetles may be found to have been seriously injurious to the coming crop by gnawing little holes in the germinating plants, so that they perish before appearing above ground; or, again, by so injuring the young plants that, where the leaves have appeared, they die off, and on examination the lower parts of the stalks are found to be eaten below ground-level. The root also is found to be gnawed in places, and these wounded parts to have turned black, and if the earth is carefully turned back, the little beetles will be found at work.

Later on, especially in bright warm sunny weather, the beetles may be found working at the leaves, and causing at times great damage; and on warm evenings the beetles come out of the ground, and, rising in the air, they pair; but where the eggs are laid, or the maggots feed, does not appear to have as yet been certainly observed. Presumably it is at the Beet- or Mangold-roots; but as the beetles themselves are only about as long as two-thirds of the height of the (o) in *this* word, it is matter of no small difficulty to be sure of securing their eggs or larvæ in the open field.

How far this infestation is a regular cause of mischief to young Mangold-plants we do not know. Enquiries are sent, and long have been, as to what may be amiss, but it was not until we had the careful observations of Prof. Harker, above alluded to, that we knew of the little beetle being a serious field pest at times in this country.

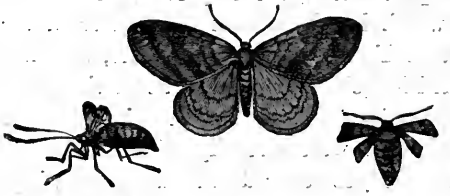
During the past season, the only certain report of Pigmy Mangold Beetle attack which has been sent me was from Mr. D. D. Gibb, of Ossemsley Manor Farm, Lymington, Hants, who noted the presence of this unusual Mangold pest, as well as of the Beet Carrion Beetle. But if when the quite young plants are dying unaccountably the specimens for examination were carefully raised with the earth adhering to them, and forwarded, so secured that the beetles, if present, could not escape in transit, we might learn a great deal as to the cause of the dying off of germinating or young Mangolds.

Where attack has been present to an extent to make its recurrence likely, the chief measures recommended are bountiful manuring, so as to run on the crop, and also liberal seeding, so that if infestation comes there is a good chance of some of the germinating or young plants surviving, and thus giving a crop; or, if not, the superfluous quantity can be thinned out in good time.

Note.—Mangold-leaf Maggot attack was present as usual last season, but as it occurs yearly, it is unnecessary to enter again upon the well-known applications which help to carry the plants over attack.

ORCHARD CATERPILLARS.

Winter Moth. *Cheimatobia brumata*, Linn.



CHEIMATOBIA BRUMATA.—Male moth; and female moths showing abortive wings.

The excessive cold of the early part of 1895 had certainly no effect in lessening infestation of the common orchard and fruit-tree caterpillars, as, for instance, the looper caterpillars of the Winter Moth, which did exceeding damage in various localities, not only to fruit-tree leafage, but also, and on a broad scale, to Oaks. Other kinds of caterpillars were more or less present; but the following notes are selected from the many observations sent me as bearing on some special points regarding the Winter Moths which it may be useful to draw attention to without repetition of what has been previously entered on.

Mr. Masters' prediction (sent on February 25th) of coming infestation shows the use of being alert in autumn whether moths are expected or not.

Mr. Goodwin's note gives definite observation of continuance of moth appearance from about the end of October up to the end of December. This is a very important point practically; and Mr. Goodwin's observation of finding Winter Moths out on the night of the 1st of March confirms previous observations of late appearance of this pest. All this joined to what we previously know of dates of appearances during the winter showing that though grease-banding at the time of the first great autumn outbreak is a most useful preventive, still that it is by no means to be wholly trusted to as an entire check to the ascent of the female Winter Moths without unreasonable amount of renewals in the later winter months.

The special kinds of trees selected for bad attack in various neighbourhoods, and amongst these the great outbreak of looper caterpillars on the Oaks of the Peckforton Hills in Cheshire, are also worth notice; but during the season of infestation, short observations of the unusual amount of mischief going forward were so frequently added to report letters regarding other insects, that more than just the chief points mentioned would be undesirable.

The following useful note, the first of the season's observations on Winter Moth, was sent me on February 25th from Evesham by the courteous and friendly contributor whom now I greatly regret to name as the *late* Mr. J. Masters:—"I am very much afraid we shall have a severe visitation of the caterpillar pest this season. Last year the caterpillars were not numerous, and many growers presuming on this would not take the usual autumn precautions. I caught more moths on the grease-bands last autumn than I have done for some years past. The severe winter has also been very destructive to small birds, so that we shall not have their help to any extent in lessening the brood of caterpillars this spring."—(J. M.)

Mr. Goodwin wrote from Canon Court, Wateringbury, near Maidstone, on the 25th of February, as follows:—"Since I last wrote to you, I have carefully studied the habits, &c., of *brumata*. I had a very good opportunity, as an orchard close to the house was severely attacked last year by the larvæ of *brumata*. Round these I had the usual sticky bands put, and took great care that the composition was not allowed to get dry. Every evening I went out to see what was happening. They commenced to emerge about the end of October, and continued to appear up to the end of December.

"The number of males and females caught on some of the trees was extraordinary. I could not count them, but there were several hundreds on one tree, and it might have run to four figures. At least ninety-nine per cent. were *brumata*, the rest being *defoliaria* and *dilutata*.*

"I also found that a considerable number of eggs are deposited on that part of the tree between the earth and the band. From close observation I could see that the females object to walking on to the sticky composition, and will delay doing so for some time, during which they deposit eggs in the crevices of the bark. I have no doubt that the larvæ from these eggs (unless they are destroyed by some means) would succeed in reaching the foliage. My grease-bands were not put very high up—only about three or four feet from the ground; but of course where stock is turned out, the bands must be put proportionately high, and the risk of having a large number of eggs below the band becomes greater.

"One thing I noticed was the comparative rareness of *defoliaria*. In the spring five or ten per cent. of the larvæ were of this insect, but certainly not more than one per cent. of the moths were *defoliaria*. This was equally noticeable in my breeding-cages. Roughly speaking,

* *Cheimatobia brumata*, the Winter Moth; *Hybernia defoliaria*, the Mottled Umber Moth; and *Oporabia dilutata*, the November Moth: all three species resembling each other in the moths appearing in autumn, or early winter, and their caterpillars infesting leafage in spring.—Ed.

about fifty per cent. of the *brumata* emerged, but only about five per cent. of the *defoliaria*."—(E. G.)

About a week later (namely, on the 4th of March) Mr. Goodwin wrote me that whilst searching for insects on the night of the 1st, he had found several "pairs" of *C. brumata*. It is impossible to say with certainty when these had emerged from the chrysalis state; but the circumstance of their being pairing points to their very recent development. Although the chief appearance of the Winter Moths is from the middle of October some way into November, we have record of their appearance as late as the end of January, and the possibility of a late development in March is one of the difficulties of fruit-growers.

In the instance observed by Mr. Goodwin, it would appear very likely that the long frost-bound state of the ground had prevented an earlier appearance of the late winter brood; but in any case the observation is of serviceable interest as showing the moths present and in natural condition immediately on the breaking up of the long cold.

Amongst widespread mischief done by the looper caterpillars in the past season, one very notable attack was that to the trees on the Peckforton Hills in Cheshire. On the 31st of May, Mr. W. Bailey, writing to me from the Aldersey Grammar School, Bunbury, Tarporley, Cheshire, on this subject, mentioned:—"The foliage on the Peckforton Hills is this year again being destroyed by caterpillars; . . . the *Oaks* are especially suffering." With his letter Mr. Bailey forwarded me a box of caterpillars collected from the Oak-trees, all of which proved to be "loopers," and almost all were caterpillars of the Winter Moth.

The above attack appeared as a devastation to *Oak-leafage;* the following report, sent me by Messrs. German & Son, from Ashby de la Zouch, on May 29th, shows extremely bad attack to *Lime-trees.*

This attack, it will be seen from the following communication, was a recurrence of infestation of the previous year, and the locality Drakelow Park, near Burton-on-Trent. Messrs. German mentioned that on June 27th, 1894, I had replied to a letter from them regarding a caterpillar attack upon Lime-trees in Drakelow Park (near Burton-on-Trent), but it was then too late in the season to send specimens. Unfortunately, however, the attack had then recurred, and specimens were forwarded. These proved to be Winter Moth caterpillars of various shades of colour, some with green ground-colour, some much browner, and some of them were full, or nearly full-grown.

The bundle of leaves sent accompanying showed great ravage. Of the seventeen or more leaves sent (for the most part averaging about three inches in length), few, if any, had less than a third eaten away, some much more, and some were reduced to merely a few ragged remains.

The above observation of severity of attack of the caterpillars was,

it will be seen, on May 29th, and it is worth notice that in about a fortnight from that date the caterpillars were entirely gone from the trees. On the 12th of June Messrs. German wrote me that "on examining the trees on Monday last" [June 10th, Ed.] "we could not find a single caterpillar. We suppose therefore that they had fallen to the ground, where they will exist in the chrysalis state until they become moths, about the beginning of October."

This matter of disappearance of great infestations of caterpillars, whether of Winter Moths or of other kinds, deserves much more attention than is usually paid to it. Messrs. German, as above noted, quite understood what it meant, namely, that the larvæ were only gone down into the ground to lay the foundation of new mischief. But too often the disappearance of the great body of caterpillars is considered to mean that this is an end of the whole affair. Consequently no measures are taken, and the next attack (which in field cultivation might sometimes have been quite prevented, and with Winter Moth might have been prepared for) takes place in natural course.

The following note, sent me on May 25th, with specimens accompanying, by Mr. H. Fawke, from Green Hill Farm, near Kidderminster, shows recurrence of attack of the Winter Moth caterpillars to Plum and Gooseberry for several years :—"I have sent you a sample of the pest that we have been troubled with for the last two or three years; they devour both Gooseberries and Plum alike."—(H. F.)

On the 14th, and again on the 17th of June, Mr. G. F. S. Warne, writing from Frolbury, near Dorking, reported a plague of caterpillars, "which this year is worse than ever," which had infested trees in that part of the country, and done great damage to the Oaks, which had especially been attacked, and also to fruit-trees, &c.

In regard to methods of prevention and remedy, the two great points to be considered are, the measures which will keep the abortive-winged moths from ascending the trunks of the trees, and also the applications, such as washes, syringings, &c., which will be serviceable when, either in natural course of things, or from the stems of the trees not having been sufficiently guarded, the caterpillars are found to have established themselves, and to be devastating the leafage. The following is a short account of how we stand regarding knowledge of these methods of treatment at present.

In 1889, consequently on the constantly increasing and serious amount of loss caused by "looper" caterpillars, for which there was no regularly proved reliable remedy, the subject was gone into with great care by fruit-growers on a large scale, and others personally interested in the matter. Grease-banding, though a great preventive,

was found to be by no means wholly successful, and on application being made to Mr. J. Fletcher, Entomologist to the Dominion Experimental Farms of the Department of Agriculture of Canada, he suggested the use of spraying with Paris-green, as being decidedly the most successful treatment known for stopping ravages of the caterpillars of the Winter Moth.

Consequently on this, a Committee of Experiment was formed early in the following year at Evesham, composed of leading men,—fruit-growers, landowners, and others of that great fruit-growing district,—in order by trials, joint examination of results at the meetings of the Committee on the fruit-grounds of the members, and publication of results (successful or otherwise), with causes duly noted, that we might have well-proved information as to trustworthy treatment.*

Taking first the subject of banding.. We found that tar (an old standing method of prevention) was wholly objectionable by reason of it soaking into the bark of any of the trees not old enough for the bark to be a mere rugged dead mass externally, and thus doing serious or fatal damage.

In regard to grease or sticky banding, we found that, though not so dangerous as tar, if spread on the bark without care as to amount, composition, and also the age of the bark, it was liable to do harm, varying in amount up to killing the trees. Therefore the plan of protecting the part over which the grease was to be applied by a band of grease-proof paper was arranged, this band of paper being tied round with a string at the upper and lower edges, and the grease smeared on to it.

Enquiries are frequently sent me as to what kind of cart-grease should be used; but from the vast number of kinds of cart-grease or axle-grease it is almost impossible to single out any one kind for special use. So far as any regular formula can be given for common cart-grease, it appears to be usually made of tallow, palm-oil, and soft-soap; another kind is mainly of rosin-oil, with apparently a little rosin, and also a little carbonate of lime; yet another useful kind, known as Frazer's axle-grease, is of rosin-oil saponified with a solution of Sal-soda in water and softened lime. These may be taken as types

* Details will be found in my Thirteenth, Fourteenth, and Fifteenth Annual Reports. In the first-named, besides other information, under the head of "Orchard Insects," will be found some special observations on sticky banding. The second-named (that for 1890, in which the Experimental Committee of Fruit-growers was formed) enters more particularly on details of our work in regard to introduction of use of Paris-green; and in the Report for 1891 are further notes, and directions for the use of Paris-green; and also some observations on mixture of soap and Paris-green, with which I was favoured, at my request, by Dr. J. Aug. Voelcker, Consulting Chemist of the Royal Agricultural Society of England; and notes of experiment by Mr. Frank T. Shutt, Chemist to the Experimental Farms of the Department of Agriculture of Canada.

of "grease" which, *beyond the action of the grease itself*, will not do harm, even if smeared on the bark.

Others, however, will do great harm to bark: of these, such a composition as "Pitt's axle-grease" would probably do immense mischief if used as a smear to be laid on the bark itself. This mixture is stated to be composed of black-oil or petroleum residue, animal grease, rosin (powdered), soda-lye, and salt dissolved in a little water. Where, however, "grease-proof" paper is *really impervious* to greasy or injurious external applications, of course almost any sticky insect deterrent may be smeared on it; where the paper is *pervious* (as may very likely be the case) damage occurs just in proportion to its inefficiency. The practical difficulties connected with "greasing" or "sticky-banding" are,—the material drying so quickly that it ceases to be sticky; or, again, where great numbers of moths are stuck fast, the bodies of these make a coating outside the sticky material over which the ascending moths may creep in safety. This is a difficulty which may very soon occur, as the male moths, being attracted to the bands by the females, a coating or sprinkling of both winged and wingless moths is soon formed.

Yet another point to be considered is deposit of eggs. Numbers of these are laid on the bands by the "stuck fast" female moths, and of these it just depends on various circumstances whether many or few will hatch out their caterpillars in due course to ascend the tree in spring. Also there is an almost certainty of an egg deposit *under the lower edge* of the sticky band, beneath the part where it is tied to the tree.

All the above matters need looking to if "sticky banding" is to be successful, and for most of them another application of the smear is enough; but the really great difficulty in the matter lies in the successive or long-continued appearances of the moths. These may go on, as noted by Mr. Goodwin at p. 63 (to take one of the observations of the past season), for a couple of months, or they may recur at intervals during the winter from the middle of October to the beginning of March, and it appears to me totally impossible to guard against this at a paying rate in great orchards where trees are grown by thousands. The greatest number of moths, the great force of the attack, however, appears to be that which comes the first, the great infestation of the latter part of October and earlier part of November; and to check this in its ascent makes an enormous difference in amount of coming evil. And here we pass to the *remedial* measures, which the imperfectness of preventive measures makes imperative only too often in the following spring.

When the caterpillars are found to be at work on the leafage, the only treatment which appears to be of really trustworthy service is

washing or spraying with applications that make their food poisonous to them, or so obnoxious to them that they will not feed on it.

For this purpose spraying with Paris-green holds the first place as an application of *certain benefit*, if applied according to the methods which have been carefully worked out as to strength, &c. London-purple, which is also an arsenical preparation, is also (in proportions fixed) very serviceable. For those who object to such amount of risk as may arise from careless application of poisonous mixture, the use of "Kerosene Emulsion" is thoroughly to be recommended; or for those who have not the knack (or do not desire the trouble) of mixing the soap and kerosene of the emulsion so that they are permanently blended, the composition sold under the trade-name of "Anti-pest" by Messrs. Morris, Little & Son, Doncaster, will probably do all that is required. This composition is very similar in the nature of its ingredients to the "Kerosene Emulsion," but being ready mixed, and only needing diluting, it saves trouble, and is much safer for the leafage than imperfectly blended emulsion, in which the separated mineral oil may do a great deal of damage.

There are other mixtures sold more or less serviceable, of which those I know best are the compounds prepared by Messrs. Stott, one of which, sold under the trade-name of "Kill'mright," I have had well reported of. This, I believe (but am not certain), has Paris-green added to a basis of soft-soap, and therefore it would be likely to be serviceable, both by poisoning the food, as in the case of caterpillars, or by choking up the breathing-pores, as with Aphides and other insects which it is not easy to poison by dressing their food, as they pierce through the outer surface to get it from beneath with their suckers. The serviceableness of soft-soap in this class of attacks has long been shown by the use of soft-soap washes for Hop Aphis.

In regard to recipes.—One for use of London-purple will be found at p. 48; the proportions and method of application of Paris-green will be found in my own short pamphlet on its use, which I am permitted to say met the approval of the late Prof. C. V. Riley, Entomologist of the Department of Agriculture of the United States, as containing a plain and correct statement of all the points necessary to be known for orchard service. This I have copies of still, and shall be happy to send to any applicant. For the kerosene and soap emulsion there are various recipes; probably the following—which I copy from a useful little pamphlet on insecticides, sprayers, &c., published by the Deming Co., Salem, U.S.A.—will be found very serviceable, as it appends special details regarding use of different kinds of soap, and advice as to management of different kinds of water:—

"The Kerosene and Soap Emulsion.—This is made after the following formula: kerosene two gallons, soap half-a-pound, water one gallon.

"The soap, first finely divided, is dissolved in the water by boiling, and then added boiling hot, away from the fire, to the kerosene. The whole mixture is then agitated violently, by being pumped back upon itself with a force pump and direct-discharge nozzle, throwing a strong stream, preferably one-eighth inch in diameter. After about five minutes' pumping, the emulsion should be perfect, and the mixture will have increased from one-third to one-half in bulk, and assumed the consistency of cream. It should adhere to glass without oiliness. Well made, the emulsion will keep indefinitely, or may be diluted for immediate application.

"The use of whale-oil soap, especially if the emulsion is to be kept for any length of time, is strongly recommended, not only because the soap possesses considerable insecticide value itself, but because the emulsion made with it is more permanent, and does not lose its creamy consistency, and is always easily diluted, whereas with most of the other common soaps the mixture becomes cheesy after a few days, and needs reheating to mix with water. Soft-soap answers very well, and one quart of it may be taken in lieu of the hard soaps.

"In limestone regions, or where the water is very hard, some of the soap will combine with the lime or magnesia in the water, and more or less of the oil will be freed, especially when the emulsion is diluted. Before using, such water should be broken with lye, or rain-water used; but better than either, use the milk emulsion, with which the character of the water, whether hard or soft, does not affect the result." *

In some cases where there is difficulty as to application of regular arsenical or other sprayings, fairly drenching (thoroughly washing down) the infested trees with water alone will do good. When attack is passing away it does much good, for it cleans off quantities of dirt and rubbish, and the copious watering of the ground in dry weather helps much towards giving the leafage a new start. Where there was plentiful supply of water at hand, and the use of a house fire-engine was procurable, I have known this answer well; only in such violent application the water should be sent rather at the trunk and main boughs, and allowed to rebound at the leafage rather than be sent directly at it, which might complete the destruction of the remains which had escaped the caterpillars.

Where there is some tree which for special reasons—legal, picturesque, or otherwise—it is important to save from ravage, and which is of too great a height to be cleared by ordinary spraying-engines, the above method will probably be found serviceable. If it should be found that the fallen caterpillars show signs of being able to crawl

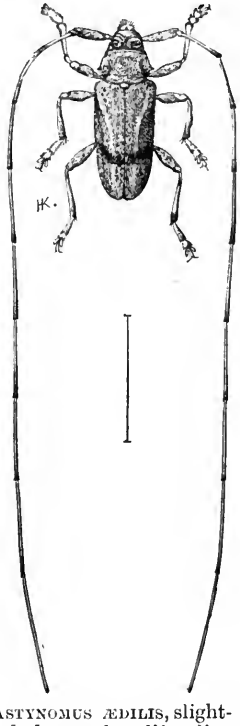
* 'Catalogue and Price List of Spraying-pumps, &c., with Recipes for Insecticides and Fungicides,' pp. 16, 17. Deming Company, Salem, Ohio, U.S.A.

back to the tree, they should, if possible, be all destroyed, or a sticky band put round the trunk at once.

Many minor methods of treatment have been found of service, as jarring the boughs to make the caterpillars fall, also fumigating, and numbers of other measures have been brought forward on variously trustworthy authority for a length of years; but looking at the records of known horticulturists in Canada and the United States, joined to those of our own country, it appears to me that, for real broadscale work, sticky banding in late autumn and early winter, and spraying in the spring when the caterpillars appear, are what we have got to trust to.

PINE.

Timberman Beetle. *Astynomus ædilis*, L.; *Acanthocinus ædilis*, S.



ASTYNOMUS ÆDILIS, slightly larger than life; line showing natural length.

The Timberman can perhaps hardly be classed amongst insects which are really injurious to Pine-timber in this country; but as it is rarely met with here, a note of its capture is worth record; and also the species is of interest from the males possessing the longest horns, or antennæ, of any of the known European beetles.

On the 12th of August the very beautiful specimen, from which the accompanying figure (a little larger than life) was sketched, was sent me by Mr. William Ross, from Kinnaird, Strathpeffer, Ross-shire, N.B., with the observation that it had been found on the farm on that day, and that neither the sender, nor any person to whom he had showed it, had ever seen one like it.

Short notes of the habits of the beetle will be found given by various German writers; but the best account I have at hand is given by the late E. C. Rye,* as follows:—"The *A. ædilis* is conspicuous for the enormous length of its antennæ, especially in the male. This . . . occurs at Rannoch" [in Perthshire, ED.], "where it may be not uncommonly seen

* See 'British Beetles,' pp 207, 208, by E. C. Rye.

flying across the glades of the Black Forest, with its long appendages streaming behind. It loves to settle on felled Pine-logs, with its antennæ spread out like compasses; from which habit it is termed by the Highlanders 'Timberman,' a name curiously enough also applied to it in Lapland and Sweden, where it is common. If two males come within range they inevitably fight, for which reason, and also on account of their delicate structure, it is difficult to obtain quite perfect specimens.

"The larva makes wide galleries and perforations in Pine-stumps, forming a nidus, with coarse gnawed fragments near the surface, in which it changes to pupa. In this state the antennæ are turned downwards, and recurved towards the middle of the head. The larva appears to be full-fed at the beginning of the summer, and, after remaining two or three weeks in the pupa-state, changes to the perfect state; staying as such in its nest until the following summer."—(E. C. R.)

Excepting at the locality where the "Timberman" is mentioned by Mr. Rye as "not uncommonly" seen, it appears to be rarely met with in this country; but on the Continent it is to be found in great numbers.

Dr. Altum observes "that after hybernation it swarms on warm days in the early spring in forest clearings, where it flies about the stack-wood and stems. Sometimes it also winters in pupal state."

Kaltenbach states that according to various observers this beetle is common in Pine- and Fir-wood, and that he had himself taken thirty in one morning in a wood-yard about Pine-wood.

Dr. E. L. Taschenberg observes that the *Astynomus ædilis*, L., has in the case of the male the longest antennæ which are known to occur in any European kind. He also notes that it lives in larval state under Pine- and Fir-bark, often perforating the wood of the fallen stems.*

From the habit of the grubs of this beetle of feeding in the wood, as well as under the bark of felled Pine-timber, it cannot be looked on as a wholly harmless infestation, and if it should be found to occur in any observable numbers at any locality, it would be well to guard against its increase; just as with the *Sirex*, the Great "Wood Wasp," which not very many years ago was looked on as only a rare insect and not worth attending to, because it might be supposed only to damage sickly or felled timber, and now it has become a regular Pine pest in various places here, and its presence has spread onwards injuriously into Ireland.

* The above references are taken from: 'Forst-Zoologie,' von Dr. Bernard Altum, vol. iii., "Insecten," p. 306; 'Die Pflanzenfeinde,' von J. H. Kaltenbach, p. 690; and 'Praktische Insekten-Kunde,' von Dr. E. L. Taschenberg, pt. ii., p. 256.

The "Timberman" Beetle is of the shape figured magnified, with natural length given by the line accompanying, at p. 70. The length varies from about half to three-quarters of an inch; the shape is depressed above, clothed with a greyish pubescence. The general colour above is of a brownish ash, or, as well described by Dr. Altum, of a smutty violet-grey, like Pine-bark. The fore body has one blunt tooth on each side, with four much smaller ones above placed transversely in front. The wing-cases have numerous minute black spots arranged to some degree in rows, and are marked across by two somewhat oblique brownish bands; the front one, in the specimen before me, only extending a little way from the outer edge. Legs chiefly grey or brownish, with grey down. The ovipositor is exserted in the female.

The distinguishing point, however, is the enormous length of the horns of the male beetle; these are from three or four times to as much as five times the length of the body, or, by measure, three and a half inches; the general colour grey, with a black line outside the lowest joint, and the others, excepting the terminal one, black at the apex; this joint is longer than the others, and very slender. The antennæ of the female are much shorter, only about twice the length of the body of the beetle. My own specimen was three-quarters of an inch in length; the expanse of its antennæ as it walked, bearing them at right angles to its body, was as near as may be half a foot; and as it moved gently along, with its delicate horns lightly arched from their strong enlarged lowest joint to their fine slender extremity, it formed a singularly graceful object.

Pine-shoot Tortrix Moth ("Post-horn" attack, German). *Retinia buoliana*, W. V.

On the 7th of June I received, by favour of Mr. R. Gough, Forester to the Duke of Bedford, from the Woods Department, Park Farm Office, Woburn, Bedfordshire, a parcel of specimens of injured Scotch Fir-shoots, with some insects accompanying, and a request for information as to the nature of the attack.

This proved, on examination, to be of the Pine-shoot Tortrix Moth, the *Retinia buoliana*. Just a few caterpillars were still unchanged to the chrysalis state, and with these, and the chrysalids, the moths, which after a time developed plentifully, and the characteristic distortion of the shoots from the larval injury which had taken place within, the attack was very well represented. The moths are said by Taschenberg to be found at the end of June, and in July from England to Russia and from Sweden to the South of Europe wherever the Firs

which they infest are to be found; yet, curiously enough, although I have seen bad attack myself, no report has ever before been sent me of it as seriously injurious.

The history of the attack, condensed from the accounts of various observers, is as follows. The moths appear at the end of June, but

RETINIA BUOLIANA.—Moth, nat. size and magnified; injured shoot.

chiefly in July, on young wood, and are mostly to be found on trees of ten to fourteen years old. Here they are little observable as they rest in the day amongst the needle-like leafage, but in the dusk of the evening they swarm about the tops of the trees; and here pairing takes place. The fertilized females lay their eggs singly between the buds at the end of the shoot, and from the gnawings of the caterpillars which presently hatch from these eggs during the later part of the summer, a flow of rosin results, which to some degree coats over the injured bud. Here the caterpillars hybernate, and with the growth of the spring shoots their presence becomes more noticeable. Then they often attack the neighbouring shoots, or one side of them, more

especially under the shelter of the resinous exudation and their spun web.

The result of the infestation is sometimes the growth of a number of small more or less deformed shoots taking the place of what should have been the leader, either to the young tree, or the affected bough, and thus giving a "besom-like" bunch of shoots round the destroyed terminal bud. Or very frequently the injured shoots assume a distinctly elbowed growth, as shown in my figure at p. 73, drawn from specimens sent me by Mr. R. Gough. The shoot may very possibly not be killed, and will in course of growth turn up again and resume the right direction; but a bent angle at the side that does not grow will have been established, and will cause a crooked stem.

Some of the shoots from Woburn showed the elbowed growth characteristic of this attack very plainly. The shoots of which the growth had been checked elbowed sharply to one side, and then, after a somewhat horizontal growth, or slightly downward inclination for an inch or two, turned up again, and continued an upright but diseased growth; the shoot thus having formed two elbows.

In some instances the whole part above the infestation was so checked in development as merely to be covered with brown or pale completely stunted leaves, or scales representing them, *i. e.*, buds containing the leaves which had not freed themselves from their sheaths, and lay imbricated to the amount of about one hundred on about two inches length of shoot; and in some the leaves, in their unnaturally close development, were produced up to about a third of their natural length.

Some of the chrysalids were, on June 17th, lying in the dead parts of the destroyed shoot, or in the chamber of web and exudation outside it.*

These I found to be extremely lively when laid in the hand. The colour was of a yellowish-brown, darker towards the thorax; and the head, and part covering the wings, dark. The abdominal segments lighter below, and at the base of seven of them up to the caudal segment a very narrow band on the upper part and sides of either very minute prickles, or minute prickle-like tubercles. These tubercles, or prickles, formed a line across the segment about a quarter of its width

* Scarcely any of the caterpillars remained unchanged; the two or three which were visible were of the yellowish tint they assume before maturity. When young they are of a darkish brown; when full-grown they are about an inch long, with small shining black head; the next segment black or blackish-brown above, with some very fine white lines; and the tail also blackish. They are to be found, according to Taschenberg, from September until May of the following year between the buds of the Fir, and later on in the young shoots; and they turn to chrysalids at the spot where they ceased to feed.

from the hinder edge; and dividing the remaining portion of the segment across into about two equal parts was a raised line, formed on most of the segments of minute tubercles. These were very small, and my observation was taken with a two-inch focus hand-magnifier; but perhaps may be worth noting in addition to Taschenberg's observation of the half-ring of prickles pointing backwards at the tail.

The chrysalis state lasts for four weeks. On examining my specimens on the 19th of July, I found some of the moths had developed, and were dead, and so much rubbed that they were hardly recognizable. A good succession, however, afterwards emerged, agreeing well with the descriptions of the *Retinia buoliana*, W. V., especially that given by Taschenberg.*

The fore wings are of various tints of yellow or rich red, marked (as figured) with lines, stripes, and spots of beautifully shining silvery markings; the hinder wings are well described as "blackish-grey, with yellowish reflections, and the fringes mostly yellowish-grey."

The only other note which I have received regarding this infestation is from Mr. E. A. Atmore, F.E.S., King's Lynn, Norfolk, who, in reply to some remarks of my own regarding the above attack, mentioned: "The larva of the little moth *Retinia buoliana* caused considerable injury to the Scotch Firs here by rendering the shoots sterile. One of these grubs feeding in a shoot will quite ruin it!" To this Mr. Atmore added:—"*R. pinivorana*, *R. pinicolana*, and *R. turionana*, also cause some little injury here to the same trees (Scotch Fir), for their larvæ feed similarly to those of the *R. buoliana;* but none of these species are plentiful enough here to cause much injury. . . . *R. buoliana* is not particular as to which shoot, or bud of a cluster of buds, the egg is laid in; but *R. turionana* is just the reverse; it always, or nearly always, selects the central bud, or shoot, and causes much more resinous exudation than *buoliana*."—(E. A. A.)

The insect mainly chooses Scotch Fir, or Black Austrian Pine, for its attacks, but does not appear wholly to confine itself to them. In the very useful volume entitled 'Forest Protection,' by Prof. W. R. Fisher,† it is mentioned that the insect exclusively attacks young growth, and prefers weakly six- to twelve-year-old plants on poor soil, and in sunny situations. Methods of preventive treatment there given are:—

"Careful planting and rearing of plantations of vigorous Pines without undue crowding.

"The shoots which are attacked may be broken off and burned.

* See 'Praktische Insekten-Kunde,' part iii., p. 200.

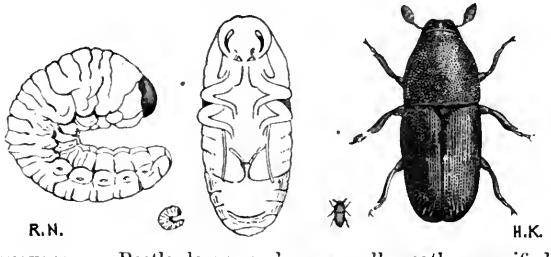
† 'Forest Protection,' by Prof. W. R. Fisher, B.A., Assistant Professor of Forestry, Royal Indian Engineering College, Cooper's Hill (being vol. iv. of Dr. Schlich's 'Manual of Forestry'). Bradbury, Agnew & Co., Bouverie Street, London. 1895.

"Removal of all misshapen stems at the first thinning, till which time they are spared to cover the ground."

Looking at the habit of the moths of flying round the tops of the infested trees in the dusk, and also that these trees are often still in reach of treatment by means of syringing, or by washes thrown from garden-engines, it would appear well worth trying whether the application of some of the various well-known kinds of soft-soap wash might not be very deterrent to egg-laying. The application of tobacco-liquor failed on trial; but the adhesive slight coating which would be given to the buds by the soft-soap mixture would especially lodge between them, and thus protect the exact locality which the Tortrix Moth selects for egg-laying. For a purpose like this the Eclair Knapsack Sprayer, sold by Messrs. Chas. Clark & Co., Windsor Chambers, Great St. Helen's, London, E.C., would be excellently adapted, as it could be carried on the shoulders of the bearer amongst the young trees, where there would be no room for the passage of a wheeled machine.

PLUM.

Wrinkled Fruit-tree Beetle. *Scolytus rugulosus*, Ratzeburg; *S. hæmorrhous*, Schmidt.



Scolytus rugulosus.—Beetle, larva, and pupa; all greatly magnified. The two latter from drawings by Mr. R. Newstead.

The above-named beetle much resembles the well-known Elm-bark Beetle, *Scolytus destructor*, Oliv., in its method of doing harm by working in grub state within the inner part of the bark and outer part of the wood, but is distinguishable (for one thing) by being a good deal smaller; the Elm-bark Beetle being from one and a half to as much as three lines in length, and the "Fruit-tree" *Scolytus* (to borrow one of its German names) only from three-quarters of a line or less to a line and a quarter long.

It is of the shape figured at p. 76, magnified, and shining, but (on account of its wrinkled surface) not so much so as the rather larger kind, the *Scolytus pruni*. The fore body is "extremely closely covered with deep oblong punctures, confluent into wrinkles in front and at sides." The wing-cases with punctures on the interstices as large and deep as those in the striæ. The tips of the wing-cases, the horns, and the legs are reddish-brown.

This kind is found on the Continent between, and feeding in, the bark and sap-wood of various trees, especially of Apple, Plum, and Cherry; but in this country it is not, so far as I am aware, recorded as more than "rather common," and until I was favoured in the past season with very good specimens of small boughs of Plum exceedingly injured by its presence, I was not aware of it being a decided orchard pest here.

On the 7th of June Mr. Robert Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, wrote to inform me that he was sending me some pieces of Plum-branches infested with *Scolytus rugulosus*, of which he observed:—"By carefully removing the bark you will find the insect in all stages, *e.g.*, larva, pupa, and imago. The branches are from Plum-trees in my father's garden at *Ince*, *Cheshire*, where the attack has proved most destructive, as also at other gardens in the same village. I have also received it from Shropshire, where it had been equally destructive. I have now had the species under investigation for nearly two years."

Mr. Newstead mentioned that he had some notes of the life-history of the beetle, which he purposed shortly to publish; and he also kindly lent me his own drawing from life of the maggot and pupa much magnified, which, with his permission, I have had copied, and insert at p. 76.

The life-history, taken from various writers, is that the little beetles appear in May or April, and begin to bore into the bark; and the females tunnel their galleries in or between the inner bark and sap-wood. Here they lay their white eggs singly side by side along the "mother-gallery," and from these eggs the grubs hatch after a few days, and feed on the inner bark by preference, but otherwise in the sap-wood. The maggot-tunnels necessarily all start off, as with so very many of the bark-beetles, at right angles from the mother-gallery, by the sides of which the eggs were laid; and when full-fed, if there is still a good thickness of bark over them, they turn to chrysalids at the ends of their tunnels; otherwise, if the bark is too thin a protection from their having eaten it away, or from other causes, they pierce a little way down into the solid wood.

This was very observable in the small branches sent me. At first, from the short tunnel down into the wood being stopped at the outside

with the powder (frass), the results of the feeding of the grub, the perforation was very likely not noticeable; but later on, when the beetles had developed and emerged, the minute shot-like holes into the wood were as observable as those through the bark, and were sprinkled in such numbers over the surface of the samples of Plum-branches sent me, that I counted sixty perforations at least in a space of one inch in width by two in length, the short tunnel varying in depth from about the sixteenth to over the eighth of an inch, and often entering the wood in a slightly slanting direction.

According to Dr. Taschenberg, the development of the beetles from the first laid eggs is completed by the end of June. This agrees with the state of the specimens sent me by Mr. Newstead. Of these he mentioned, on the 18th of June, that (so far) he had only been able to obtain three larvæ and one pupa. This certainly must have been referable to the grubs having left their tunnels and gone down into the wood, for on June 21st I found the beetles had been developing numerously. The dust which had dropped from their workings induced me to make a careful examination as to what had been going on, and at first only a few of the beetles were noticeable in the box; but on moving the pieces of infested branches, I found numbers of them were present, running about fast and actively.

In the case of Canon Schmidberger's observations, the larvæ continued feeding until late in the autumn, the beetles from these coming out in the next year; and it does not seem absolutely certain whether there are customarily two broods in the year. Where the beetles, however, come out in June, it is entirely presumable that it is the grubs from the eggs of these that furnish the beetles which come out in the following spring, and start attack as mentioned above.

The Plum-branches sent me (which were destroyed by the severity of the attack) were from a small size up to as much as four and a half and five and a half inches in circumference. I do not find notes of attack of the beetle to tree-trunks, nor does it appear to be likely, as the grubs live much in the soft inner part of the bark, and they would not find the nourishment requisite, excepting in comparatively young branches, or where, as in Canon Schmidberger's experiments, the trees were still so small that they were grown in pots.*

Prevention and Remedy.—Mr. Newstead mentioned that he had advised burning infested trees, and this probably is the very best method of prevention. He also mentioned that as an experiment he

* For various works to which reference is made above, or in which accounts of this infestation will be found, see:—'Praktische Insekten-Kunde,' von Dr. E. L. Taschenberg, part ii. p. 246; 'Injurious Insects,' by Vincent Kollar (Trans.), p. 263; 'Europäischen Borkenkäfer,' von W. Eichhoff, p. 157; and 'Forst-Zoologie,' von Dr. Bernard Altum, iii., "Insecten," 1. Abth. p. 224.

had tried painting the bark with a strong mixture of whiting and Paris-green; "but this had little or no effect on the perfect insects; they bored through it and laid their eggs."

But though the above did not answer, possibly the mixture recommended by Prof. W. Saunders, Director of the Experimental Farm of the Dominion of Canada, and a most excellent authority on economic entomology, for prevention of various kinds of fruit-tree-bark borers, would be found very useful for preventing perforation of the bark for egg-laying when the insects have emerged. This consists of soft-soap reduced to the consistence of a thick paint by the addition of a strong solution of washing-soda in water; "this, if applied to the bark of the tree, especially about the base or collar, and also extended upwards to the crotches, where the main branches have their origin, will cover the whole surface liable to attack, and if applied during the morning of a warm day, will dry in a few hours, and form a tenacious coating not easily dissolved by rain." *

For the special bark-borer attack for which this has been a complete defence, it is recommended to give a coating of the above solution early in June, and a second time early in July, and this date would probably answer as well for defence against our Plum-bark beetles; but at any rate the principle would be the same,—to give a protective wash as soon as the beetles begin to appear, and another somewhat later.

The fact of their emergence being begun may be known by the appearance of little perforations, like small shot-holes, in the bark, and fine dust from the workings of the insect having fallen from them. In the case of the pieces of branches sent me, there was a good deal of this "frass" thrown out.

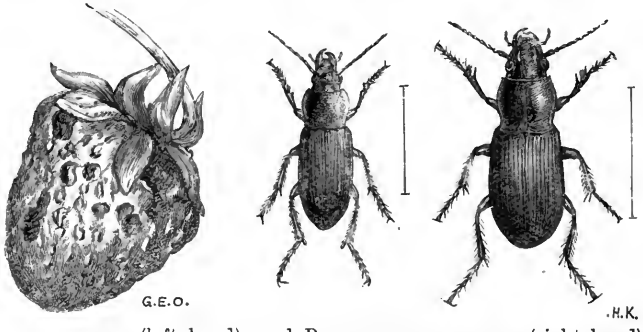
For special application where it is desired to protect valuable trees from infestation, Dr. Taschenberg recommends the use of Leinweber's mixture. A good recipe for composition of this will be found in Prof. W. R. Fisher's exceedingly useful work on 'Forest Protection' †:—"Five pounds of tobacco mixed with half a pailful of hot water, kept hot for twenty-four hours; the water is then squeezed out of the tobacco, and mixed with half a pailful of bullock's blood, one part of slaked lime, and sixteen parts of cow-dung. This is kept in an open tub, and stirred once a day, and used after fermentation has set in. The rough bark-moss, &c., is trimmed off the tree, and the latter painted with the mixture for three successive days until a crust is formed which the rain will not wash off."

* See 'Insects Injurious to Fruits,' by W. Saunders, F.R.S.C., &c., p. 19.

† 'Forest Protection,' by W. R. Fisher, Assistant Professor of Forestry, Royal Indian Engineering College, Cooper's Hill, &c., p. 250. Bradbury, Agnew & Co., Bouverie Street, London. 1895.

STRAWBERRY.

Ground Beetles. *Harpalus ruficornis*, Fab.; *Pterostichus* (*Omaseus*) *vulgaris*, Linn.; *Pterostichus* (*Steropus*) *madidus*, Fab.



HARPALUS RUFICORNIS (left hand), and PTEROSTICHUS VULGARIS (right hand), magnified, with lines showing nat. length; Strawberry fruit gnawed by *H. ruficornis*.

The attack of "Ground Beetles" to Strawberry fruit, which in 1894 did much mischief at Woodborough, in Nottinghamshire, on the grounds of one Strawberry grower, showed itself again in the past season, and on a much more serious scale. It appeared in many places in the district in great numbers, and attacked the fruit just when it was beginning to ripen, so as to cause serious losses.

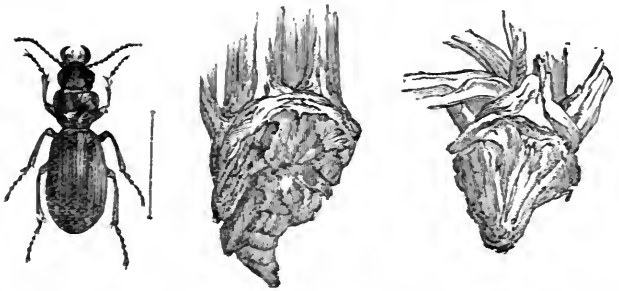
The so-called "Ground Beetles" (*Geodephaga*, scientifically) were formerly supposed to be almost entirely of carnivorous habits. There were some exceptions, or partial exceptions, and we owe to the researches of Prof. S. A. Forbes, State Entomologist of Illinois, U.S.A., most of the information (so far as I am aware) which we possess up to date regarding the nature and proportion of vegetable food to be found on dissection and study of contents of many kinds of the predacious Ground Beetles.*

Also the habit of the Corn Ground Beetle, the *Zabrus gibbus*, of feeding in grub state on the roots of corn, and in beetle state on the milky grain in ears of Barley, has long been well known.

But with regard to what may be called straightforward feeding at solid root-crops or fruit, so as to do demonstrable damage by the rood or by the acre, I am not aware of the fact having been recorded until within the last few years, when we have had observation of them on Mangolds in this country, and on Strawberry fruit in this country and in Holland.

* See Twelfth Report of the State Entomologist of Illinois, U.S.A., for the year 1882, pp. 105–116.

In 1885 I had specimens of the *Pterostichus* (= *Steropus*) *madidus* sent me, by Mr. T. J. Mann, from near Bishop's Stortford (with samples of young Mangold-roots accompanying), as examples of the great damage which was then being done to his crop by the nocturnal, or very early morning attacks, of this beetle to the portion of the Mangolds just about ground-level.



PTEROSTICHUS (= STEROPUS) MADIDUS, magnified, and line showing nat. length; young Mangold-roots gnawed by the beetles.

The above figure is taken from some of the injured Mangolds sent me as "good types of how they were eaten off," and of the kind of beetles (of which samples were also sent) caught early in the morning in the act of eating the Mangolds; and it is added here as the *Steropus madidus* is one of the kinds of Ground Beetles which, both in the past season of 1895 and in the preceding summer, attacked the Strawberries in Lincolnshire.

In 1892 another kind of Ground Beetle, the *Harpalus ruficornis*, was identified by Dr. J. Ritzema Bos, Director of the Phyto-pathological Laboratory, Amsterdam, as being found in great numbers in the Strawberry-beds at Goes, in Zeeland, Holland, and being very hurtful to the ripe fruit.*

In 1894 observations were forwarded to me by Mr. M. J. R. Dunstan, Director of Technical Instruction for the County Council of Nottinghamshire, of attack on Strawberry fruit by Ground Beetles at Woodborough, in the above-named county. The actual berries were attacked by the beetles, who came on them at night in great numbers. The injury was to three roods, and the crop was ruined. The attack was watched, so that there might be no uncertainty as to the cause of the mischief, and samples of the beetles taken proved, on trustworthy entomological identification, to be of three distinct species of Ground Beetles, namely, *Pterostichus* (= *Steropus*) *madidus*, *Harpalus ruficornis*, and *Cala-*

* See 'Kurze Mitteilungen über Pflanzenkrankheiten und Beschädigungen in den Niederlanden in den Jahren 1892 und 1893,' von Dr. J. Ritzema Bos. Separate impression from 'Zeitschrift für Pflanzenkrankheiten,' iv. Band, 3 und 4 Heft; also 'Biologisches Centralblatt,' xiii. Band, Nr. 7 und 8, pp. 255, 256.

thus cisteloides. For the detailed information placed in my hands regarding this attack, see my 'Eighteenth Annual Report,' pp. 93—97.

In the past season, namely, that of 1895, Ground Beetle attack to the ripe and ripening Strawberries occurred again, not only at Woodborough, but at other places in the district, to a very serious extent, as will be seen by the following notes, and especially by the detailed report of Mr. Rice.

A good supply of the injurious beetles was sent to myself, which enabled me to identify them, and for the sake (in such an important fruit crop matter) of having the opinion of a known entomological expert to rest on besides my own, I submitted specimens to Mr. Oliver E. Janson, F.E.S., who verified my identifications, and pronounced them correct.

These Ground Beetles proved, as before, to be *Harpalus ruficornis*, *Pterostichus* (=*Steropus*) *madidus;* and also *Pterostichus* (*Omaseus*) *vulgaris*, Linn.

Of these, the *Harpalus ruficornis*, Fab. (which was by far the most numerous kind in the consignments sent), is of the shape figured at p. 80; average length six to seven lines; pitchy black; antennæ and legs red or fuscous, rarely black; thorax (fore body) with hinder angles acute, thickly punctured at the base, less so at the other margins; the wing-cases are faintly striated, and clothed with a grey or golden down, and beneath them are ample wings, which they use freely for flight.

For those who have to do practically with these injurious Strawberry Beetles, it would be well worth while to raise the wing-cases, and by spreading the wings folded beneath, to see the size and power of the wings by which they can transport themselves wherever attraction of food may take them.

The *Pterostichus vulgaris*, Linn., is wingless. This beetle (figured, as well as the above, at p. 80) is rather larger than the *H. ruficornis*. It is from six and a half to seven and a half lines, or rather more, in length; the colour entirely black; the fore body rather broader than long, and the hinder angles, though pointed, yet more bluntly so than in *ruficornis;* the wing-cases strongly and smoothly striated.

The *Pterostichus* (=*Steropus*) *madidus*, Fab. (figured, magnified, at p. 81), is (or may be) rather larger than the *vulgaris*, the length running from half-an-inch to over two-thirds. It is wingless and black, though sometimes the legs have red thighs. It is distinguishable from the other species of *Pterostichus* mentioned above by the hinder corners of the fore body being rounded behind so as to be narrower than the base of the wing-cases. For this compare figures at pp. 80 and 81.

The above notes of general appearance give perhaps enough

description of three of the four kinds of Ground Beetles found at the Lincolnshire Strawberries for general purposes.

Of the fourth kind, *Calathus cisteloides*, Panz., I did not find any samples in the specimens sent during the past season. This is a good deal smaller than the above-mentioned kinds, being from about a third to half of an inch in length; colour black, with horns and legs brownish-red. It is of the same general shape as the other Ground Beetles; but it may be distinguished to some degree by the fore body being slightly narrowed in front, sinuated behind, and the hinder angles rounded off. The wings abortive, or imperfect.

In Mr. Rice's notes of the infestation, he mentions (p. 85, speaking of the *only kinds* of beetles found) that, besides (1) the brown, and (2) the black (*i. e.*, the *H. ruficornis* and the two species of *Pterostichus*), there was a third kind, which "seemed to be a small edition of No. 1." This I presume to be the *cisteloides*, as its reddish or brownish legs and horns would give it a strong resemblance to the *H. ruficornis* in "small edition," and this species was properly identified as being one of the Strawberry attackers of 1894.

It will be seen in the second report of observations sent by Mr. W. Rice on July 24th (given after that immediately following), that this special beetle, the smallest of the kinds found at the fruit, appeared later on in July in great numbers.

The first information sent me during the past season of the re-appearance of this destructive attack to Strawberry fruit was given in the following letter, written June 23rd by Mr. Joseph Smith, of Woodborough, to Mr. Dunstan, and forwarded on to myself:—"We are having a good crop of Strawberries this year. We worked the land, and used soot and salt, and worked it well in, according to your orders, but we have a large quantity of beetles. They are eating the fruit fearfully this week; the first week was not so bad. We think the pest is worse than last year; and others are suffering quite as much as we are at this present time.

"We have put flesh down, and killed a large quantity in a morning; but they are still very numerous, and we are very anxious to know if there is anything else you can recommend to us."—(J. S.)

On the 3rd of July, Mr. M. J. R. Dunstan, Director of Technical Instruction for the County Council of Notts, wrote me further on the subject, with specimens accompanying:—"I am sending you a tin of the beetles which attacked the Strawberries, a bunch of the attacked fruit, and a report made by Mr. Rice on visiting the field yesterday. . . . There seems an opinion that the beetles appear where the town manure—a general collection of refuse from ashpits, &c.—has been used."—(M. J. R. D.)

Of the beetles sent me, the greater number, somewhere about two

dozen, proved to be *Harpalus ruficornis*, five *Pterostichus* (*Omaseus*) *vulgaris*, and one *Pterostichus* (=*Steropus*) *madidus*; for descriptions of which see p. 82.

I give the report of Mr. Rice *in extenso*, as it contains a deal of very useful information, as,—increase of the area affected in 1895 compared with that in which the presence of the beetles was mischievous in 1894; and also the serious amount of injury caused, both to ripe and green fruit. Also some points desirable to be known regarding the habits of the beetles, as,—the method in which they lie sheltered round the plants in the day in vast numbers, and their activity at night; and the clearness of the fruit from other kinds of insect attack, and from the attacks of other kinds of beetles than those mentioned in the report. Also the fact of the beetles being observed in the act of feeding on Strawberry fruit; and also that on some of them being placed in a tin with fresh fruit they settled down at once to the attack. Also various other points useful to know regarding practicable methods of trapping found to answer in lessening numbers; nature of soil, &c. And also two short notes of "local opinions" as to possible cause of this injurious visitation with which Mr. Rice begins his report, both of which are worth consideration, and especially the first regarding "sanitary manure." This being composed of the clearing of ashpits under "sanitary" regulations, from which the manure takes its name, and being consequently a mixture of all kinds of garbage and rubbish (some of which, as meat and fish, I found, in the course of my experiments, these carnivorous beetles would eat eagerly), would be very likely to be an attraction to the beetles, and a centre from which they would spread.

The report of Mr. Rice, made on July 2nd, is as follows:—

"Local Opinions.—(1) That beetles came through heavy dressing of sanitary manure. (2) That absence of moles (which have been killed by thousands during the last three or four years) allows the beetles to multiply.

"The only crop affected last year was that of Mr. Smith" [see observations of damage at Woodborough, p. 94 of my 'Eighteenth Report,' Ed.]; "but now others are suffering as badly, and in many places the district swarms with them, yet several large growers are not attacked. This year the attack began when the fruit was full-sized, and within three days of ripening.

"A part of a field planted with Strawberries was valued at £10 as they were, but the owner dare not sell for fear of the pest; and a few days after the would-be buyer was called in to see them in ruin, the crop only fetching some thirteen or fourteen shillings as gathered by

the owner; while the mass of the other plantings have been left an utter wreck, the whole crop being marked by the beetles.

"The beetles lie round the plant, and under the earth, which is covered with straw and litter, having their holes and runs through the earth and litter; the opening being through the litter and just under the bunch of fruit attacked. The beetles are without number, and seem most active an hour after dark, being full and dormant at break of day, and much deeper in the soil. The beetles are very quick and alert, which makes it very difficult to catch them actually eating the fruit, though some were so found; and beetles supplied with clean untouched Strawberries in a tin settled down at once to the attack, and commenced by taking out the seeds one after another, keeping hold of each for a few seconds. The only beetles were—(1) the brown; (2) the black; and (3) what seemed to be a small edition of No. 1. Also a few of a rusty-red colour, and half the size of No. 1.*

"The Strawberries as a whole are clean from any attack of small insects; only two from hundreds examined having any life on them which could be seen by a small glass, and which seemed like young green fly. The ground was entirely free from grubs, and even next morning, after a hard rain, the number of common snails was not an ordinary average. Some of the large holes in the riper fruit seem as though possibly the common snails had been at them, though the mass of the fruit is free from any injury past that of the outside skin.

"The green fruit is really cleared of its skin, and many of the seeds left. . . . The green Strawberries dry up and wither after an attack, while those riper turn moist and soon rot.†

"The soil is full of soot, and has been also heavily dressed with salt; but where the soot can be seen making the soil black, the beetles are quite at home. The soil under each plant is full of underground channels, and is quite eaten away. The ground seems to have been cultivated when rather stiff and hard, and the humps of soil left, so as to form a ready hiding-place for the beetles which are so numerous.

"The only mole I could hear of was in the field of Strawberries belonging to a man suffering very heavily from the pest, yet he claims where the mole works the fruit is more or less untouched."

(The beetles have been caught by vessels set below the ground-level, into which they fall, and are killed by some destructive mixture). "Also flesh, covered by pieces of thick sacking, attracts a number, which are easily killed; yet both methods do not diminish the vast multitude to any degree."

The following further observations were sent by Mr. W. Rice on

* For identification of beetles, see p. 82.—Ed.

† Mr. Rice also noted that in the case of the riper fruit the seeds were especially attacked, and lay under the berries as thickly as hail.

July 24th, showing that the severe attack was still continued, with an increased amount of the small kind previously noticed, and some additional details regarding state of ground, *non*-presence of *insectivora*, &c. :—

"Notes, July 24th.—Beetles still on the Strawberries in vast quantities. A well just dug has the surface of the water entirely covered with the beetles. The small kind, to all appearance a tiny edition of the brown large ones, now swarm everywhere, and seem on the increase. The villagers complain that the beetles now infest their homes." *

With regard to treatment of the ground, Mr. Rice observed :—

"Some of the fields worst affected were dug and left rough round the Strawberries, thus affording an easy shelter for the beetles; while, where the ground in the same fields was left undug after the winter, the Strawberries have escaped the pest. Some of the fields badly infested were not cultivated with town manure, but supplied from piggeries."

Regarding the absence or scarcity of moles and of birds, Mr. Rice remarked :—

"The district as a whole has few moles, and where they are unknown the pest is worse. The whole district has few birds this season through the loss of the past severe winter. Hedgehogs have been tried, but at present the success is unknown. Agricultural salt was largely used, but with no effect."—(W. R.)

From the above observations and careful investigations of the Strawberry growers in the district where the crops were infested by the Ground Beetles on the ripening fruit, there was no doubt of the very serious nature of attack, and the identifications of various skilled and trustworthy entomologists (independently of my own) left no doubt of the beetles causing the devastation being Ground Beetles, *Geodephaga*, that is, of the kinds specified.

But, beyond this, being desirous of watching the method of operations of the beetles, I took the opportunity of the numbers sent me for special observation. Firstly, on July 4th, I put about eight of *H. ruficornis* in a glass jar together with four good-sized ripe Strawberries. On the following morning I found, on examining the Strawberries, that each of the berries had been more or less eaten on the surface. Sometimes the outer surface was destroyed by being gnawed away in

* Regarding the disposition of the *H. ruficornis* to get into houses, John Curtis writes in 'Farm Insects,' at p. 218, of his own observation of them "as abundant in one season in the garden, house, and outhouses"; and when at Fontainebleau, several of the beetles flew to the candles in the evening, "showing they are nocturnal, and provided with ample wings for flight."

patches, and sometimes the injury had gone deeper, and a hollow about a quarter or even half an inch long had been gnawed into the substance of the berry. The absence of the seeds drew attention to where merely superficial mischief had been going on, and in some instances the seeds had been hollowed out, and only part of the husk remained.

For seventeen days, that is, from the 4th to the 21st of July, I continued my observations daily of the attacks of the *ruficornis* on the Strawberry fruit. This fruit I usually renewed every evening, taking care to examine each individual berry before placing it in the jar, so as to be quite certain that there was no insect infestation present, nor any injuries that could be confused with those *caused* by the beetles. Thus I was absolutely certain, so that the extent of the damage could be given by measurement, and figured of the serious amount of damage to the fruit; and also, as I kept the glass-jar containing the beetles, the Strawberries, and about a tablespoonful of carefully examined earth, well tied down over the top, that there was nothing present but the *ruficornis* Ground Beetles to do the damage.

The result of my daily observations, usually taken in the morning and carefully noted in detail, was that the injury was of various kinds to the outer part of the fruit; sometimes little pits, about the eighth of an inch across, were hollowed out, or these pits might be more or less confluent with the surface of the berry damaged between them, so as to form a patch half an inch long. In another berry a quarter of the surface would be gnawed; in another (a fine berry more than an inch long) much of the outside of the fruit was ruined by the beetle-gnawings, which, besides removing the outer part, gave a slimy mashed-up appearance to the fruit from the pulling at it of the strong beetle-mandibles. The state of the attacked part was in great contrast to the unattacked part of the berry, which remained glossy and bright, with the seeds in regular position.

In a few instances the pits gnawed were as much as a quarter of an inch or upwards in length, and from removal of seeds and roughening of portions of the surface, even where worse damage was not done, the selling value of a crop so treated would have been spoilt.

For about twelve days the beetles ate about the same amount daily or rather nightly), and excepting that they appeared to prefer the ripe side of a Strawberry in case the other side was not wholly matured, they appeared to eat without choice of part of the fruit. One of the beetles had died at the beginning of the experiment, presumably injured by handling, and another got away, so that the numbers experimented on throughout in this special jar were six *ruficornis*, which appeared to keep in perfect health on their Strawberry diet

throughout; and on the 19th and 20th of July, that is, the fifteenth and sixteenth days of their captivity, I found that they were pairing. After the 21st of July, as, excepting that sometimes the beetles ate less and sometimes more, there appeared to be nothing of further interest to observe, I noted them less carefully.

The result of the seventeen days' careful observation showed that the *H. ruficornis* fed willingly and healthfully on the Strawberry fruit, *and on this food and nothing else* they continued for the time recorded above in their natural state of brisk activity, and also, as observed above, carrying on their natural functions.

After the above date, as it was not so necessary to be certain that there was no other presence in the glass-jar, I gave the beetles a little fresh earth taken from the surface of a garden flower-border, so as to allow them about three-quarters of an inch depth to bury themselves in. This they did willingly, and also partially covered their Strawberries with earth; and on the 27th I found their supplies of berries were so covered with fine earth, that it was impossible to say, from the general wet, "messed" condition, what had been done at any one spot to the fruit; and this attempt at burying suggested that the perishing fruit, which I let remain, and which soon became a mass of mould or fungus-threads, was purposed to be a receptacle for their eggs.

The above notes refer solely to *H. ruficornis* at Strawberry fruit; but on the 26th of July I received about two dozen more of the Strawberry beetles from Mr. Dunstan, of which, on examination, seventeen proved to be further specimens of *H. ruficornis*, and six of *P. vulgaris*. These gave me the opportunity of seeing that it was no peculiarity of the special beetles under examination (no idiosyncrasy, so to say) to eat nothing but Strawberry fruit, but that this, and meat (cooked or raw), fish, bread, live worms, or the parts not too hard for their mandibles to deal with of an insect, were all (apparently equally) acceptable as articles of food. And also that though Strawberries were eaten greedily, they would not, as far as I could see, even taste any of the other kinds of fruit which I placed in their jar.

On arrival, presumably, the beetles were hungry, and I dropped a good-sized rather over-ripe Strawberry among them. This the greater part of the beetles fairly *attacked* at once, those that could not shelter below crowding on the top, and in a very short time they had eaten away much of the outer surface, and deep down into the fruit. Taking the remains away, I dropped two little worms and one fair-sized earth-worm, about four or five inches long, into their glass jar, and these were at once attacked. One of the *Pterostichi* seized one of the small worms and, setting its legs firmly, fairly dragged it along; but to the larger worm most of the rest of the beetles made a simultaneous attack. The work was begun in many cases almost as if by an

instinctive knowledge of their powers, for small parties settled along the worm with their heads opposite to each other, and thus pulling hard with all their powers against each other with their strong mandibles, they soon tore through the skin. On examination about an hour afterwards, I found that some parts of the worm were not noticeably injured, but much of it was worked away into a mere thread of gnawed shapeless matter. There was no apparent difference in the eating-powers of the two kinds of beetles, and after about two hours and a half they appeared to have had enough; but afterwards, on some fresh Strawberries being given them, some of the beetles went at the fruit immediately.

The savage ferocity with which the beetles ran at their food and tore it to pieces by daylight on being taken from the tin in which they had travelled, was no doubt owing to their long fast, but the method of attack was the same in their ordinary customs. With uncooked meat they would fairly tug at a small piece to detach it, and then walk away to eat it at leisure; and on one occasion I found one of each of the two species of beetles holding on to one piece of meat, and dragging it and each other in all directions in their struggle to possess it.

The daily examination showed they worked at their Strawberries; but all other kinds of fruit which I supplied them with appeared to be totally untouched, neither would they have anything to do with some egg-shell still containing some moisture within. Uncooked mutton they ate greedily, notwithstanding that a slight sprinkling of salt had been given to the joint from which it had been taken; and cooked meat, such as rabbit kidney, or cooked haddock or salmon, appeared quite acceptable. Bread, when given in a rather thin slice, they pierced through with small holes up to about an eighth to three-sixteenths of an inch in diameter. They did not, however, prey upon each other, although they attacked the soft parts of a *Sirex gigas* (the Great Pine Wood Wasp), which had been sent me for identification, and was still fresh.

The above observations I carried on at their somewhat tedious length relatively to the opinion held in the infested districts of the beetle attack being very probably connected with the use of ash-pit clearings for manure, in which all kinds of scraps of animal matter are thrown, and the result, so far as was shown by the small scale on which I was able to experiment, as well as the quantity of beetles attracted by the "pieces of flesh" (see p. 85) placed as traps, appears to point strongly to the probable attraction of what may be called garbage. Once established, the *H. ruficornis*, the brownest of the beetles, which is furnished with powerful wings, and which uses them for flight at night, would spread wherever the presence of the ripe fruit

attracted it, and so the beetles would be found at the fruit quite independently of what manure might have been used for the special Strawberry-ground.

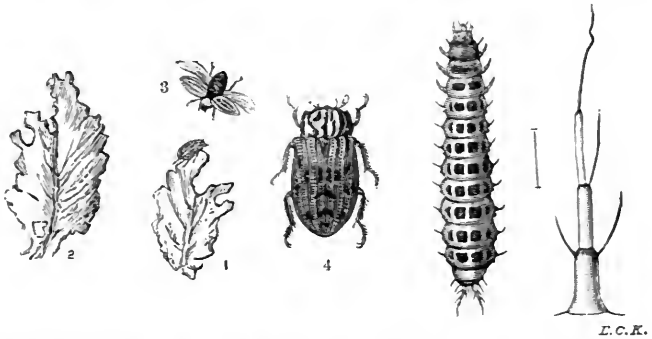
Of the two kinds of *Pterostichi*, having only abortive wings, there would be hope of clearing the ground, or at least of their not spreading unless carried in soil. These (that is, the *P. vulgaris*) were beginning to pair on the 29th of July (the pairing of the *H. ruficornis* had occurred at least nine days earlier), therefore egg-laying might shortly be expected; but though clusters of eggs were reported as seen, it seems open to doubt whether these could be of the Ground Beetles, which would be so small as to be difficult of observation. But later on the grubs would be hatching, which, like those of the Ground Beetles generally, might be expected to be long, parallel-sided, fleshy, and somewhat flat above; the head and first segment hard; the six legs horny; and the tail extremity with two horny or fleshy appendages, somewhat like fleshy bristles, on the upper surface, and beneath to be furnished with a caudal foot.

Whilst these grubs are young and tender some dressing *might* kill them, but the only application which it appears to me would be likely to do this without injuring the Strawberry-plants would be Paris-green, used either in dry or fluid mixtures. A very careful series of experiments have shown that this was not absorbed into the plants experimented on; and there might, I think, be such good hope of it poisoning the young grubs, that it may be worth the trouble of trial.

The only other preventives and remedies appear those of trapping mentioned at p. 85.

TURNIP.

Turnip Mud-beetle. *Helophorus rugosus*, Oliv. = *H. fennicus*, Stephens.



HELOPHORUS RUGOSUS, flying, and on leaf, nat. size; also magnified (after Rye); larva, and one of pair of caudal bristles, magnified. Turnip-leaves gnawed by beetle.

In the past season Turnip attacks have occurred as usual to a greater or less amount, but not on a scale of widespread injury—as in 1881 regarding Flea-beetle, and in 1891 regarding Diamond-back Moths—requiring special record; nor, excepting here and there, as in the case of the application of basic slag as a remedial dressing on leafage infested by the "flea," has there been (so far as I am aware) any new contribution of serviceable information as to methods of prevention and remedy. Therefore I have only noticed in detail the infestation causing damage to the tops of Turnip-bulbs, and injury to growth and edges of leafage, caused by the so-called Turnip Mud-beetle, the *Helophorus rugosus*.

This infestation was first reported from Inverurie, in Aberdeenshire, in 1889, and all the reports since have either been from Aberdeenshire or the immediate neighbourhood. Likewise, until the 28th of Sept., 1894, when specimens of the grubs were also sent me showing their presence as injurious feeders both in the upper part of the Turnip-bulbs and in the leaf-stalks, the reports sent only referred to it in beetle state.

The accompanying figures (magnified and life-size, or with line showing length) are from specimens sent with the injured material, and the beetle was figured from one of several picked from small Turnip-plants, of which *two were in the act of consuming the leaf*.

On September 5th of the past season specimens were sent me by Mr. Robert Ironside, of Auchlossan, Lumphanan, Aberdeenshire, with

the following remarks:—"I send you per this post a Turnip, and also specimens of a grub that is doing much harm in a few fields about ten miles from here; . . . the farmer told me that the field would be completely ruined."

The grubs proved to be of the Turnip Mud-beetle (*H. rugosus*), some darker in colour than the others, and apparently about to pupate. The small leaves of the Turnip were much eaten away in some parts; also there were several grubs at the base of the leaves.

From such dates as have been sent with previous samples and reports, it appears that the injury may be found so far established as for attention to be drawn to it, by the diseased appearance of the tops of the plants, as early as the second hoeing of Turnips sown on the 5th of June. On investigation there was nothing wrong at the roots, but on breaking away the unhealthy leaves, the grubs were found sheltered close down where their stems leave the bulb, "and a great many of them in the centre of the shaw, eating up the young growing leaves."

There were sometimes as many as a dozen grubs of different sizes at one shaw, and the description given of the "confined, upright appearance with the edges curled over," which was sent me in one of the most detailed reports in 1894, well describes the external appearance of some of the samples sent.

Besides the above-mentioned injuries, I found, on examining infested Turnip-bulbs sent me much later on in the year (on the 12th of November), that the maggot-burrow was to be found at the top of the Turnip-bulb, running as a roughly-gnawed and uneven gallery mainly round the base of the central growth of leaves. This injury was just under the skin or bark of the bulb, though sometimes it went a little lower; also sometimes it was little more than the width of the maggot, sometimes gnawed to two or three times its width. This necessarily doing harm, both by setting up decay, and checking proper growth of the leafage.

The grubs, when seen magnified, are of the shape figured, and of a pale ground colour, marked with a transverse band of darker tint across the three first segments, and a double row of squarish grey spots along the abdominal segments, with a row of smaller grey spots on each side below. The head is of a chestnut-grey colour, with strong chestnut-coloured jaws. With regard to date of presence of the grubs, as they have been in numbers, and of different sizes, at Turnips sown in the first days of June *at the second hoeing*, and I have had them sent early in September and early in November, there must either be a second brood, or they must be continuing from eggs laid at different dates during the summer.

The beetles are of the size figured at p. 91, and marked as shown

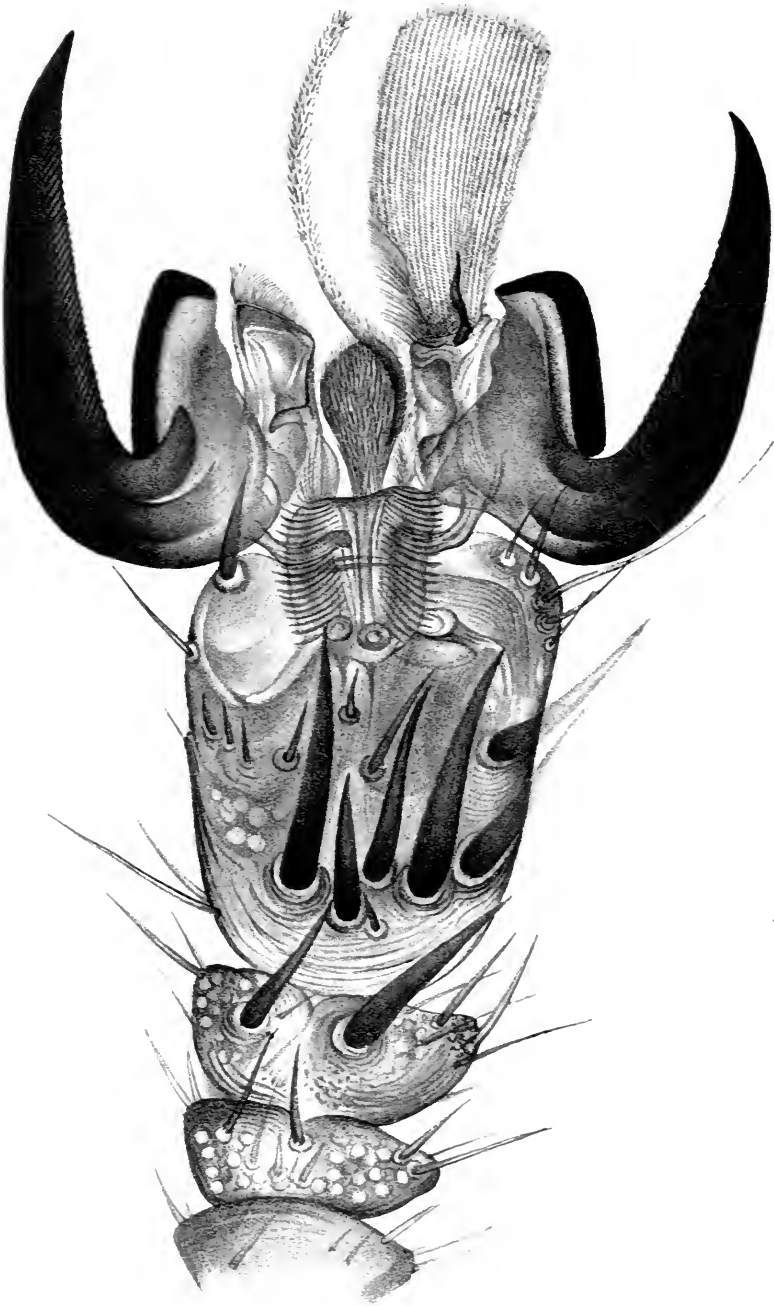
in the magnified figure. The general colour (when washed free of the clinging dirt, a very necessary operation with this kind of beetle) is rusty or rusty-red; the wing-cases ochrey or greyish, with dark spots. The fore body is marked above (as figured) with various forked or wavy grooves, and the wing-cases are punctate-striate, with the characteristic peculiarity of the spaces between being raised in a clean smooth ridge. The earliest date at which I have received these beetles was, as near as may be, June 26th, but they had been watched at work on the leafage previously; and I have had the beetles, as well as the grubs, sent at the beginning of November.

But what we still need in order to be able to prevent recurrence of the attack is knowledge of where it is that it goes into the chrysalis or pupal state. From the few notes that we have of first observation of the pest, it might be supposed that it hybernated on the infested ground, and came from this to attack the adjacent crop in the following year. In 1889 Mr. John Milne, of Inverurie, who is a thoroughly trustworthy observer, wrote me that he had "observed Turnip-fields attacked at the side next a former Turnip-field here and there throughout this part of the country" [Inverurie, Aberdeenshire, Ed.] "for over thirty years. It is most seen in crofts (small farms) where the lots are in narrow stripes; in some places I have seen the portion of a lot next the last year's Turnip lot quite half-eaten."—(J. R.)

The Helophoridæ, the family of beetles to which this Mud-beetle belongs, are mentioned by Prof. Westwood as often flying "about in the hot sunshine"; so they could easily transport themselves on the wing to where there might be attraction; but still the fact of special infestation occurring on the *specially adjoining* new crop to where the old one suffered, appears to point to the creatures remaining present there, and hybernating either in beetle or chrysalis state.

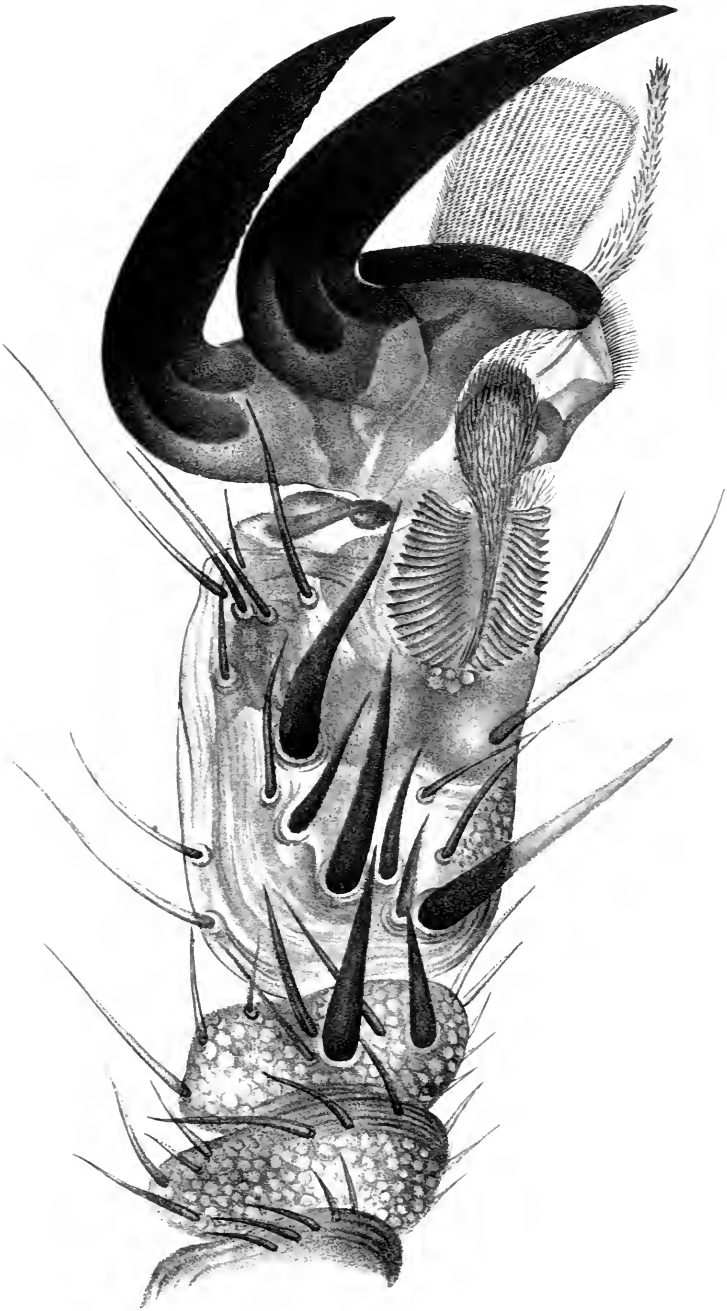
This attack does a good deal of mischief, as noted by Mr. Robert Turnbull, Inspector of Technical Education under the Aberdeen County Council, who wrote me in 1894 regarding the grub attacks:—"They eat the surfaces of the Turnips and leaf-stalks into holes, and also burrow into the leaf-stalks. During the past two years this mode of attack has been very common, and the farmers complain that rain gets into the holes thus made in the tubers, causing decay to set in."—(R. T.)

For the above reason, and also because it appears very likely that a part at least of the unexplained failures in growth of the central leaves of the Turnip might be found if investigated to be due to presence of this infestation, I have drawn attention to it again, although it has been already noticed in my Reports for 1889 and 1894.



Horace Knight sd nat del. West Newman lith

Foot of Forest Fly (Hippobosca equina *Linn.*)
Seen from above greatly magnified.



Horace Knight ad nat. del.

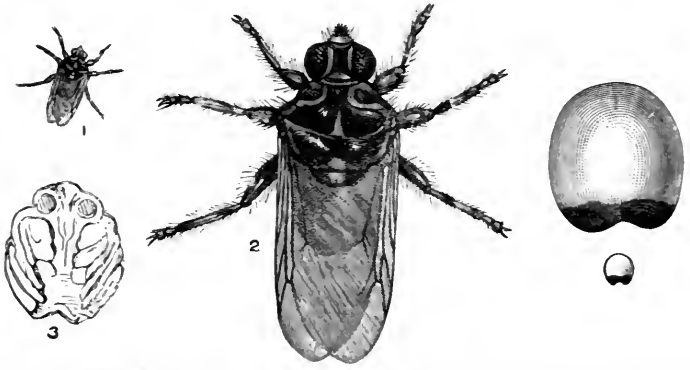
West, Newman. lith.

Foot of Forest Fly (Hippobosca equina, *Linn.*)
Side view greatly magnified.

FLIES INJURIOUS TO HORSES, CATTLE, &c.

1.—**Forest Flies.** Hippoboscidæ.
2.—**Gad Flies.** Tabanidæ.
3.—**Warble Flies.** Œstridæ.

Forest Fly. *Hippobosca equina*, Linn.



Hippobosca equina, 1 and 2, nat. size and magnified from life; 3, pupa removed from egg-like puparium (after Réaumur). Puparium, nat. size and magnified, before complete colouration.

During the past season such an unusual amount of inquiry has been forwarded (with specimens accompanying) regarding attacks of Diptera (two-winged flies) to horses and cattle, that it has seemed most convenient to place these animal attacks by themselves as a second part of the year's Report.

These include notes on Forest Flies, found troublesome to many kinds of animals; also mention of a good many kinds of British Gad Flies (Tabanidæ); and likewise some additional information regarding Warble-attack, especially as affecting red and roe deer, which was kindly contributed, and is now given under the requisite headings.

The Forest Fly (figured above with its wings folded as when at rest) has been brought into more than ordinary notice during the past season, consequently on the New Forest, in Hampshire, which is the especial English locality of this horse and cattle pest, having been chosen as the scene of our autumn military manœuvres. As the fly has generally been considered as only a local trouble, little attention

has been given to it in this country beyond the area of the district in which it is mainly to be found; and last year's observations have added something, both to our knowledge of its structure and habits, also of its distribution in this country, as well as regarding preventive measures.

For those unacquainted with the *Hippobosca equina*, our Forest Fly, it may be convenient just to mention, as a kind of general description to begin with, that the fly is about a quarter of an inch long, flat and broad-made, and when in flight appears of a bright shining black. It is a blood-sucker; but the chief annoyance which it causes is by its power of running with great activity backwards, forwards, or side-long, and so irritating the skin, or dragging the hair on the tender parts of the horses, which it especially infests, as to cause such discomfort and terror to animals unused to it, as often leads to great inconvenience, sometimes to serious accidents. Also it has the great peculiarity of only existing *actively* in fly state. It is produced not as an egg or ordinary maggot, but in a condition answering externally to the pupal stage, whence the division to which this fly belongs takes the name of *Pupipara*.

Localities.—In this country the Forest Fly is most especially to be found in the New Forest, in Hampshire, or in the vicinity, where it may have been conveyed on infested animals. In the first notice with which I am acquainted of observation of the *H. equina* as a horse and cattle pest in this country, which was given by Jean Barbut in 1781, in his work on English examples of the Linnæan genera,* he mentions, p. 319, that he has received these insects from the New Forest, where they are to be found in great numbers.

More recently various localities have been named, mainly in the south of England, where the Forest Fly has been considered to have been observed; but the only other place where I have certain personal knowledge of it being found in this country was during the past summer on coach-horses at Beddgelert, in North Wales.

In consequence of some correspondence then taking place as to localities in which Forest Fly was to be found, inquiries were sent by the editor of the 'Veterinary Record' to all the members of the Royal College of Veterinary Surgeons in Carnarvonshire, and on June 26th three specimens were sent by Mr. Morris Williams, of Pwllheli, which I found to be quite certainly of the *H. equina*, Linn., commonly known as the Forest Fly. Of these Mr. Morris Williams wrote as follows †:—

* 'Genres des Insectes de Linné, constatés par divers échantillons d'insectes d'Angleterre.' A Londres, MDCCLXXXI.

† See number of 'Veterinary Record' for July 6th, 1895, to the editor of which I offer my best thanks, both for use of the information, and for a sight of the specimens.—E. A. O.

"I have made further enquiries, and find that they are only seen in the district from the beginning of June to the middle of September.

"The neighbourhood from which they come is a wide valley running from Portmadoc to Beddgelert at the foot of Snowdon. Ponies are kept on the mountains on both sides in the summer, as well as a herd of ponies that are on the lowland both summer and winter. The village of Beddgelert being eight miles (without railway) from Portmadoc, and also being the nearest ascent to Snowdon, the horse traffic is very great along the road which runs under the mountain, especially in the summer season.

"These flies were captured on one of the coach-horses on the above route by Joseph Davies, coach-driver, Prince Llewelyn Hotel, Beddgelert."—W. Morris Williams, Pwlheli, June 26th, 1895.

The presence of the Forest Fly at such a great distance from its special habitat appears to be of a good deal of practical interest, as its unsuspected infestation in other localities might prove to be the cause of sudden unaccountable unruliness, sometimes causing a deal of trouble.

Description of the Fly.—The Forest Fly (*Hippobosca equina*, Linn., scientifically) is known also as the "Spider Fly," from its spider-like appearance when the abdomen is distended by the single embryo; also as the "Flat Fly," from its flattened appearance under other circumstances; and also sometimes as the Horse Louse; locally, in the New Forest, the flies are often known as "Foresters."

The length of the fly from head to tip of tail is about a quarter of an inch; total length, including wings when laid flat along the back, three-eighths of an inch; the shape flattish; and the skin in great part so hard and leathery as to be difficult to crush. The general colour above deep shining brown, somewhat mottled with tawny-yellow.

Head shining, rounded, flattened before, tawny-yellow, with a dark stripe down the middle of the face. Compound eyes dark and very large, occupying the whole sides of the head; *ocelli*, or "simple eyes," none; antennæ very short and sunk in pits, the end joint round, and bearing a long terminal bristle, and a shorter and smaller one.

The mouth parts consist externally of a narrow proboscis-like apparatus, pitchy or blackish; this is composed of two pieces which have a power of separation, but when applied one against the other form, by their concave inner surfaces placed together, a sheath, or elongate case, for the true trunk, or sucking-tube, which the insect can lengthen or withdraw at pleasure, and which to moderately powerful microscopic observation looks like a long yellowish some-

what horny or membranous thread, capable of great extension, and also very flexible at the extremity.*

The thorax (*or body between the wings*) slanting off at the shoulders, which have each a large patch or irregular ring of tawny-yellow above, with more or less of the brown ground colour in the centre, some small pale markings along the middle of the hinder part of the thorax, and a pale spot in the centre of the scutellum (that is, of the small portion of the upper part of the thorax just preceding the abdomen).†

Abdomen brown, grey below, and, like most of the fly, more or less beset with bristly hairs.

Wings two, strong and membranous, slightly opaque and brownish in colour, and furnished with several strong dark veins placed along the front portion of the wing, as exactly figured from life at p. 95. The *halteres*, or poisers, of moderate length, and with a thickened head, but not noticeable without removal of the abdomen.

Legs rather long (when extended flatly in horizontal movement of the insect they appear very long); of great strength; colours tawny-yellow, clouded or ringed with brown or black; the thighs mostly brown, with a ring of tawny near the extremity; and the two posterior pairs of shanks mostly tawny-yellowish in the middle, with a ring of brown at each extremity.

Each foot (or *tarsus*) is terminated by a pair of claws, and each of the pair is formed of one large, very strong, much curved, black claw, at the outside of which is placed another much shorter and thicker, forming a kind of thumb-like appendage to the main claw. On placing the curved claw in a good light, I found that the lower parts of the sides were furrowed by minute grooves placed parallel to each other, also that the lowest part of the claw had running beneath it a regularly serrated or scalloped edge, each groove running down to a notch in the saw-like edge (see Plates, and also following figure). Thus, when the fly exercises its power of pressing the sides of the curved claws together, they form a pair of flat-sided forceps, than which nothing could be more perfectly adapted for holding fine objects, like the

* The number of *setæ* of which this trunk is composed is differently given by various investigators. Latreille gave it as two, Duges as four, and Prof. Westwood as three; for detailed account see 'Classification of Insects,' by Prof. Westwood, vol. ii. pp. 582, 583. In my own observations it has appeared to me that the great power of sweeping surfaces possessed by the flexible end of the trunk pointed to possible drawing-in of fluid for food from the surface of the skin of infested animals, as well as from beneath it, and may (if examined into) confirm the popular belief of the Forest Flies imbibing skin perspiration as well as sucking blood.—E. A. O.

† The presence of the single pale spot on the scutellum is one of the especial differences between the *H. equina*, Linn., and the *H. canina*, Rondani. See 'Muscaria Exotica Musei Civici Januensis,' by Prof. C. Rondani, Annali del Mus. Civ. di Sc. Nat. di Genova, vol. xii. p. 164.

hairs, amongst which the presence of this fly causes such well-known discomfort, or even terror.

This file-sided and saw-edged structure of the large curved claw is to be found in our *H. equina* (see Plates). I have also found it in the *H. maculata*, Leach, the Indian Forest Fly (see figure accompanying of portion of claw much magnified), and presumably is to be found in the case of other species; but in observation I could only get a satisfactory view of the parallel grooves by examining the claw in natural

Foot of *Hippobosca equina*, showing double claws, central process, and long prickly bristle; also portion of side of claw of *H. maculata* (also magnified), showing parallel grooves and saw-edge.

condition, dry, and as an opaque object, and also with a bright side light. In this way the clear lines of alternating light and shadow showed the ridges and furrows excellently, but in Canada balsam I was not able to distinguish them.

The long bristle-like appendage, originating beneath the foot, and extending fully to the length of the curved claws (see figure and Plates), the "*poil barbu*," or bearded hair—first, I believe, noticed by De Geer in his 'Mémoires' on *Hippobosca*—was very noticeable. In these observations, besides other structural details, he notes the existence of this foot appendage of a bearded hair, "*poil à barbes*," referring the reader for details to p. 288 of the same paper (referred to below), where, under the heading of "*Hippobosque verd*"—the *Hippobosca* (now *Ornithomyia*) *avicularia*, Linn., the Spider or Forest Fly infesting birds—he describes the appendage thus:—"Between the '*pelottes*'" [pads or pulvilli, Ed.] "there is placed a very remarkable bearded hair, having bristles at each side like a little feather, which is

* See 'Mémoires pour servir à l'histoire des Insectes,' par M. le Baron Charles De Geer, vol. vi. p. 279. Stockholm, MDCCLXXVI.

attached beneath the foot. We have already mentioned that the *Hippobosca* have a similar hair appended to their tarsi."—(C. De G.)

This appendage is figured *in situ*, Plate 16, fig. 27, of the volume above quoted, and there shows plainly as a hair, or rather bristle, very much bearded with side hairs and placed between the pads ("*pelottes*"), which are widely expanded to show it, and projecting beyond them for about half their length.

The appearance of this hairy bristle I found to differ greatly according to it being viewed in natural condition or in balsam. In the latter, instead of the whole length of the many hairs placed along the bristle being visible, only the lower portion was clearly noticeable, this giving the bristle itself the appearance of being set with short spines. The terminal extremity appeared to be not pointed, but ending in about five spines, or moderately sharp spine-like tubercles (see Plates).

This hairy bristle is also shown, but only enough magnified to give a general idea of its structure, in the figure of the foot of *O. avicularia* in Walker's 'Insecta Britannica (Diptera),' vol. ii. pl. xx. fig. 3*b*, after a drawing by Prof. Westwood. Also Dr. Schiner, in his description of the characteristics of the genus *Ornithomyia*, mentions this appendage of the foot as projecting like a thread, and slender, but also beset with hair.*

In the course of attention that was directed to the subject of Forest Fly in the columns of the 'Field,' and also of the 'Veterinary Record,' some notes were given from his own personal microscopical observations of the existence of this "bearded hair" as a foot appendage both of the Forest Fly and of the "Sheep Tick" (*M. ovinus*) by Mr. Thos. B. Goodall, F.R.C.V.S., with figures accompanying, in the 'Veterinary Record' for May 25th, 1895, p. 636. Mr. Goodall observed:—"In addition to two strong mailed claws there is a plume-shaped body situated between the cushions, or pulvilli, beneath the feet, and extending to the length of the claws. The same organ may be observed in the *Melophagus ovinus*, or Sheep Tick (which, however, is no tick, but a wingless fly). In the latter, however, it is more feather-shaped than in the Forest Fly, being, in this insect, tubular, and covered with hair-like scales."—(T. B. G.)

In the exigencies of newspaper printing, the delicacy of representation necessary for showing minute differences of structure can

* " . . . das *Empodium* ragt fadenformig vor, und ist oben zart, aber dicht behaart."—See 'Fauna Austriaca: die Fliegen,' von Dr. J. R. Schiner, ii. Theil, p. 646; and at p. 649 of the same work Dr. Schiner mentions regarding the *Melophagus ovinus* (our so-called Sheep Tick), "Haft-lappchen" [that is, pads or pulvilli, Ed.] "und *Empodium* deutlich"; but, beyond their being "observable," does not give description.

hardly be attained, but the presence of a hairy bristle is very obvious.

In the course of my own observations of method of progression of the fly, I noticed what appeared to be a great peculiarity in its method of adhesion to vertical surfaces, and on minute examination such a complicated structure of the lower portion of the foot, that, as I was unable to find description of this in works to which I had access, I took the opportunity of having the foot figured so as to give all the details clearly, excepting that the structure being so thin and transparent that it was easily pressed somewhat from its right position by the covering glass of the slides. Therefore the figures are taken (respectively) both from above and as a side-view to show the position of the various parts clearly.

On watching the procedure of the Forest Flies when confined in a small cardboard box with upright sides, and a glass cover which allowed of observation of their movements through hand-magnifiers up to two-inch focal power, I could not perceive that they made any use of their strong curved claws to help them in the ascent of the vertical sides. Where I could gain a good view, the claws were thrown up so as to be clear of any attachment at all, and the fly progressed upwards, apparently holding on by the thick basal part only. The position would be precisely shown by placing the wrist (in our own case) firmly down on any flat substance and raising the hand and fingers at an obtuse angle; and on investigation I found a small appendage, which, when properly displayed, proved to be the thin broad membrane, with plume-like channels or ridges, curving from each side of a central vein or tube, and with a bulb thickly covered with what appear to be short hairs, which is figured in the two Plates.

In the view from above, this flap and bulb are in their correct central positions; in the other they are pressed to one side; but the connection between the flat plume-like flap and the bulb are clearly given, as also what appear to be several openings (circular orifices) at the summit of the central (?) tube.

The general appearance of this plume-like broad membrane will be seen at first glance to bear a most marked resemblance to the flexible lobes, known as *labellæ*, which form the terminal portion of the proboscis of the Blue-bottle Fly.*

Of this (the flexible lobes), the author of the work remarks at p. 192:—"These will of course be closed up like the leaves of a book, and not opened out as seen in the photograph. . . . Each lobe contains about thirty channels, some of which spring from an inner marginal tube on each side, and all are open to the air by a narrow

* See figure, much magnified, given in 'Our Household Insects,' by Edw. A. Butler, B.A., B.Sc., plate ii.

groove along the under surface." Details are given at some length by Mr. Butler, amongst other points, of the structure of these tubes, "which," he says, "on account of their superficial resemblance to tracheal tubes, are called *pseudo-tracheæ*. . . . They are, of course, not breathing-organs, but serve as a sucking and straining apparatus for conveying to the mouth the juices on which the fly feeds."—(*Loc. cit.* p. 193.)

This, in respect of feeding, would not be the use in the case of foot service of the Forest Fly, but a "straining apparatus" would be exceedingly appropriate so placed; and I have ventured to draw attention to them, as though I fear I may be merely speculating on the uses of apparatus well known to skilled dipterists, yet, if so, I will ask excuse, as I have not been able to find description of the appendages; and in any case the figures of the wonderfully delicate foot-apparatus which enables the Forest Fly to make itself so thoroughly at home on its hosts will be of interest to many.

Perhaps I may add that the microscopic slides were prepared for me from quite fresh specimens by Mr. J. Pillischer (optician), of 88, New Bond Street, London; and the figures—which I think are very beautifully executed—were drawn for me by Mr. Horace Knight, of the artistic staff of Messrs. West, Newman & Co., 54, Hatton Garden, London.

Habits of the Forest Fly.—The following notes, sent me on the 2nd of May by Mr. Thomas B. Goodall, F.R.C.V.S., of Purewell Cross, Christchurch, Hants, were among the first communications with which I was favoured in the past season on the habits of the Forest Fly.

Mr. Goodall observed that "horses bred in the forest take no notice of it, though, strange to say, the donkey will never tolerate its presence, but will use the most frantic efforts to dislodge the fly.

"Most strange horses become accustomed to it in a few days; but some never do. I have an old cob (now a pensioner) that I brought here from Leicestershire twenty years ago, and even now a Forest Fly crawling over him will drive him almost mad.

"I do not believe that it is the cause of any direct harm to the horse, though it does take its nourishment of blood from its host.

"A strange horse is frightened because of his inability to dislodge the fly, its power of prehension being so great that the horse's tail is powerless to remove it, and it crawls over the body of the horse, and does not remain quiescent until it finds a thin part of the skin, where, in the Forest ponies, it may sometimes be seen in clusters. The favourite parts being round the anus, on the perinæum, and on the inner parts of the thighs.

"When a strange horse has a 'Forester' (as this fly is called locally)

on him, he shows symptoms which at once tell us, who have experience in the matter, what ails him. He has a frightened look, lays his ears back, and makes short stamps and kicks with his feet; and if the fly is not taken from him, he will sometimes sweat profusely, kick violently, and even roll.

"I do not think the fly ever goes into a stable of its own accord; and if the horse is freed from them before going into the stable, he is safe from attack until he is taken out again. The custom here is to search the horse well all over, particularly in the fly's favourite haunts, before he is taken into the stable, after being in the 'fly' district, which is the New Forest, for *we never find them away from the Forest*, unless they are taken by horses.

"As you may imagine, there is some danger to one unaccustomed to the habits of the fly, and also of the horse, in attempting to dislodge the fly. It will, when disturbed, make short flights from one part of the body to another, and then *run*, generally sideways. Strangers will sometimes endeavour to knock it off, like an ordinary fly, which is useless, and increases the irritation of the horse.

"The *only* method is to clap the hand or fingers *flatly over the fly*, and then remove it; and it is killed by pressing the thumb-nail into the thorax lengthways.

"I really know of no specific for preventing attack, though wiping the horse over with a paraffin rag renders him less inviting to the fly; but when we know that it may settle on any part of the body, it will readily be seen how inconvenient it would be to do this often or daily, and (as I have already said) we here simply catch and kill the fly, and take no further notice of it.

"It has been erroneously stated that the fly has a strong flight; this is not so. It only uses the wings to reach its host, or to take a short flight from one animal to another, or from one part to another of the animal on which it first alights.

"When at rest on the body of the horse, *one wing overlaps the other*. . . . I have heard it said that the wings are deflexed, which is incorrect."—(T. B. G.)

Writing to me on May 10th on the above subject, Mr. Goodall observed: "The Forest Flies are out again now, and are as plentiful as the Blue-bottle"; and on the 29th of May, in reply to a request of mine for some specimens, he noted: "They are not so much in evidence since the advent of this cold weather." Shortly after he favoured me with a good supply.

The following notes are from observations with which I was favoured by Mr. D. D. Gibb, of Ossemsley Manor Farm, Lymington, Hants, with specimens of the Forest Flies sent accompanying from time to time, which enabled me to study their structure, and to some

degree their habits. On the 8th of May Mr. Gibb wrote: "I find the New Forest Flies are now fairly plentiful, the warm sunshine having brought them out from the sheltered haunts, and under the bark of old trees, where they hybernate."

In regard to their powers of annoyance, and especially by clinging to hair, Mr. Gibb remarked:—"All owners of horses who have been for any length of time in the neighbourhood of the New Forest are familiar with the pest. The body is tough, like india-rubber; with its toothed claws it can retain a very tenacious hold of the hairs of animals, and when pulled, so tight is its grip, the outer sheath of a hair will be seen to peel like the bark off a twig.* No slight rub, or switch from an animal's tail, will therefore dislodge it, or drive it away. This may set it in motion, when it may fly to another part, or cause increased irritation by running about. The movements are quick and somewhat crab-like, which tickle sensitive animals.

"When first some horses make its acquaintance they are very restive, and frequently become unmanageable; donkeys will sometimes roll and kick for an hour in their endeavour to get rid of the fly. On the wild ponies (and cattle) which run in the Forest these flies are frequently to be seen in clusters like bees."

In regard to the method of feeding of the Forest Flies by blood-sucking, Mr. Gibb mentioned that he had closely watched them on a young Arabian pony turned out to grass on the edge of the Forest, and had taken them *in the act.* The skin was very clean, so that nothing else could be found, and when examined blood was found. Yet the bite seems less irritating, as the animal was not much disturbed by the flies when sucking blood. And in another letter Mr. Gibb also mentioned regarding the above points:—"It will take blood, as I have frequently killed flies containing the same, and fully distended by the quantity they had taken. Yet I believe most flies examined will be found without. And animals do not seem to mind the presence of these flies so long as they remain at rest.

"On cattle running in the Forest, flies are to be seen in clusters numbering many hundreds without the animals feeling disturbed. The parts where these flies congregate do not become tender, so their bite must be of a mild form, else I think cattle could never become so reconciled to their presence."

* This power of the *Hippobosca* of splitting the hairs to which it adheres will be found mentioned in the number of the 'Field' for August 3rd, 1895, p. 219, by a correspondent writing from Cachar, India. In this it is mentioned:—"I have often amused myself by grasping the fly by the wings between finger and thumb, then allowing it to catch the hair on the back of my other hand. So sharp is the claw, that the hair grasped by it is cut to shavings like wood by a carpenter's plane."—(J. B. D.)

That the Forest Flies are blood-suckers is a fact which has long been proved; but still it appears to me open to doubt whether it does not also draw in the moisture of the skin through its sucking-tube. There is a strong popular idea that it does so, and the fact noticed by Mr. D. D. Gibb, that it is by no means always that blood is to be found within (on opening the fly), appears at least to point in the above direction. In the course of my own observations I found that some of the flies which I kept in confinement swept to and fro with the flexible extremity of the trunk on the part of the cardboard which I had slightly wetted, as if they were trying to imbibe the moisture. This point would, I think, be worth enquiry for practical purposes.

Reverting to Mr. Gibb's letters regarding methods of prevention, he mentioned:—

"Well-groomed horses afford least attractions for these flies. *The common remedy* adopted by those driving in the Forest with an unseasoned horse is to damp a cloth with paraffin, and rub lightly over the animal, particularly the parts beneath and under the tail, which are most subject to attack. For some years I have used, with excellent results, a carbolic sanitary fluid prepared by Mr. Johns (chemist), High Street, Southampton, which is clean and far from offensive in use, and effectual in keeping off Forest Flies. When added to hot water it mixes very readily, giving the water a milky appearance. For dressing, or rubbing over with a wet cloth, two tablespoonfuls to a gallon of water would be sufficient. To wash animals over, if desired, one pint to twelve gallons of water would be the quantities. Doubtless McDougall's or Jeyes' preparations would serve the same purpose. Train-oil is a very old remedy with natives of the Forest, but it is offensive and dirty."

The following practical remarks as to accustoming horses to attack were given me by Mr. Moens, of Tweed, Lymington, Hants. On the 1st of June, Mr. Moens wrote:—"With horses strange to the Forest Fly we put some flies on them and, seeing that their head-gear is good, let them kick themselves until tired in the stalls. After a short time we find horses get used to them, but some never will. When the flies trouble them much, the thing is to keep the horses going fast, so as to get very hot, as the flies do not care for this *; the worst thing is to stop them, unless one stray fly is on the flank, when it is easily caught with a clap of the open hand."

Life-history of the Forest Fly, *H. equina*.—The important part in the life-history of this fly is that, like others of the division of the

* Conjecturally, because the perspiration amongst the hair keeps them from moving about freely, and also clogs the fine apparatus of their feet. See Plates.

Pupipara to which it belongs, the egg is hatched, and the maggot (or *larva*) feeds and is nourished up to maturity within the abdomen of the parent fly. When fully developed this larva is deposited not as an ordinary maggot, but as a *puparium*, or pupa-case, within which the larva is then completing its immediate change to the pupal or chrysalis state, and from which puparium the perfect fly emerges, it may be in about a month, or it may be after a much longer period, according to weather and other circumstances.

Thus the Forest Fly never exists *actively* on the infested animals excepting in *imago* (that is to say, in fly) state. It cannot be called *oviparous*, as assuredly it does not lay an egg, and as although it is considered that the fully developed larva, or maggot, has not turned to the pupal state within its case at the *moment* of deposit, yet this change takes place so almost immediately, and the change *externally* by which the "case" hardens and otherwise assumes all ordinary characteristics of a *puparium* also occurs in such a few hours, that the name of *Pupipara*, or "pupa-bearing," was bestowed on this division of *Diptera*, or "two-winged" flies, by Latreille, and continues to be still their distinctive appellation.

In the course of the hundred and fifty-six years which have elapsed since the discovery was first made by Réaumur of the true nature of the egg-like body deposited by the Forest Fly, an enormous amount of attention has been given to the *internal* embryological development, but still the *external* conditions, although well known by technical observers, are by no means as generally known as they need to be for practical use; as, for instance, the egg-like *puparium* is still often believed (before it has coloured) to be an egg, and afterwards to be in some way connected with presence of Ticks. Therefore in the following pages some amount of detail, which may be of interest, as to the points in the life-history of the Forest Fly which practically concern ourselves are given, with references quoted to the original authorities, and also a list of works consulted is appended, where those who desire to enter on the early internal development (the "embryology") of this and various other species of the *Pupipara* will find full microscopical details.

The first discovery of the method of propagation of the *H. equina*, being by deposit of the egg-like body which proved to be really the *puparium*, was made by Réaumur in the middle of the month of October, 1739. But the season being then too late to continue investigations, it was not until September 18th in the following year, 1740, that he was able to continue them (*and to this day his observations on this part of the history leave nothing to be desired either for clearness or accuracy*).

Then he again found the egg-like body, of which the history was

then unknown, deposited by the *H. equina*, and to secure (as far as possible) temperature and circumstances in which this, the first of many puparia subsequently experimented on, might be successfully developed, he placed the "egg" (?) in cotton in a bottle safely corked up. This he carried by day in his pocket, by night it rested under his pillow, and after thus carefully treating it for nearly a month he witnessed the development. "It was not until the 17th of October that I saw the egg open, and I found *not* an insect which had to grow and to undergo transformations; but a fly in all points similar to that by which the egg had been laid, and of which all the parts were of equal dimensions with the dimensions of the parts of that by which the egg had been produced.*

"The egg-like body" [that is, what proved to be the puparium, Ed.] "when deposited was white, with the exception of the two projections at one end, the space between them, and some amount of the parts in the vicinity of the notch" [for shape, see figure, p. 95, Ed.]; "the envelope hard and firm, and becoming still more so as it changed to a brown colour, and thence in about twenty hours to a shining black, when it could resist a considerable pressure."—*Loc. cit.* p. 583.

The next point in investigation was to trace out the method and progress of development of the fly in the *puparium*, and the first step was opening one of the egg-like bodies which had been deposited four days later than that from which the *H. equina* had been seen to emerge, and in this, not quite developed (that is, still in pupal state), the Forest Fly was observable (see figure 3, p. 95).†

The compound eyes ("*yeux à réseau*," or reticulated eyes) were already of a reddish colour, and so also were the two external mouth-processes, which together form the sheath of the trunk. The rest of the pupa was white, excepting some tufts of greyish hairs; and the hinder extremity of the pupa, or "nymph" (as it was then called), was placed against the notched hinder extremity of the puparium, with which, as will be seen on reference to the figures at p. 95, it corresponds in the shape of its own notched or heart-shaped end.

To trace the history in its entirety, Réaumur opened specimens of the egg-like puparia at different dates after deposit by the female *Hippobosca*, as of three weeks, ten, five, four, three days, and one day

* 'Mémoires pour servir à l'histoire des Insectes,' par M. de Réaumur. Paris, MDCCLII. Tome sixième. Quatorzième mémoire, p. 580.

† This figure is copied from figure 21, plate 48, of Réaumur's illustrations accompanying his paper previously cited, and (as pointed out by the late Professor Westwood) it is much to be regretted that this plate is so little known. It contains twenty-three figures showing the *H. equina* in its various conditions, with numerous details, presumably from other observations made by M. de Réaumur in the same paper, figured with a magnifier of rather more power than half-inch focus.

after deposit, and also by opening the abdomen of various of the female flies at different dates before deposit,—that is to say, when the abdomen had reached various degrees of enlargement.

Thus he traced the pupal presence in the *puparium* back to the condition of "*bouillie blanchâtre*," or whitish pulp, of which the microscopic powers of those days (in the case of the power used by Réaumur rather stronger than half-inch focus) were not sufficient to give the minutiæ of formation; also he traced back through its immediately earlier stages the presence of the white body presently to be deposited.

His memoir on the *H. equina* is well worth studying, not only on account of the sound information given by the writer, which stands to this day as the original authority of much of what is most useful to us practically in our knowledge of this horse pest, but as an example of careful working forward of the matter under observation, and, where uncertainty arose, simply giving an exact description of what he saw, but leaving its nature as a subject for further investigation.

Following on the same ground, and desiring (to use his own words) to verify for himself the admirable observations of his precursor, the well-known entomologist De Geer, on the 28th of July, 1770, commenced a similar series of investigations, which, with their confirmation of Réaumur's records, discussions of involved points, and some additions, as well as observations on the allied genus the *Ornithomyia*, will be found as referred to below.*

Taking the main points of the development of the *Pupipara* within the abdomen of the female, it appears that the life-history may be shortly stated as follows.

The young maggots (larvæ) develop, in the same way as those of other insects, from a fertilized egg; only in this case the hatching takes place inside the female, instead of after the egg has been laid. In the case of the Sheep Tick, or Spider Fly (the *Melophagus ovinus*), the egg is stated by Leuckart to be of a long and rather slender shape, the greatest length being somewhat over one millimètre (that is, the twenty-fifth part of an inch), and the breadth rather over half a millimètre.

The abdomen is covered with a continuous membrane capable of great distension, which occurs in the females by reason of the larva feeding and growing within; this feeding being stated to be carried on by swallowing the secretion of large glandular appendages of the uterus. When full-fed the larva, of which there is only one (although the females are furnished with a pair of remarkable ovaries), is deposited in the shape of a soft whitish egg-like body (which answers

* 'Mémoires pour servir à l'histoire des Insectes,' par M. le Baron Charles De Geer. Stockholm, MDCCLXXVI. Tome sixième, vi. Mém.

to the ordinary fly chrysalis-case, or puparium); the larva immediately on deposit completing its change from the fully developed state in which it was produced to the pupal state, and its case so rapidly changing in external character, that in twenty-four hours or less, in the case of the Forest Fly, the soft whitish body has changed to the brown or black colour and the hard exterior of the perfect pupa-case, from which the perfect fly emerges, by cracking off one end of its case, in about four weeks. In the instance especially watched by Réaumur, the time occupied was from the 18th of September to the 18th of October*; but it is considered that hybernation sometimes takes place in pupal state.

The above gives to the best of my power just so much of the main points of the life-history of the *Pupipara* as may be needed for common purposes, digested from the works of the chief writers on the subject, including amongst these the observations of our own eminent entomologist, the late Prof. Westwood, which are not only valuable in themselves, but also as giving references to the chief authorities on the subject up to date. Likewise information from Dr. Leuckart's work on the *Pupipara*, which, to those who can find time to work through the eighty-two quarto pages of minute record of profound personal research, with confirmation or correction which he considered called for of previous observations, is invaluable to students of the propagation and development of the *Pupipara*.†

Dr. J. R. Schiner places the matter of the puparial deposit of the Hippoboscidæ very plainly in a few words:—"The females instead of eggs lay immediately fully-formed pupæ, whence these and all the genera of this family are called *Pupipara*." ‡

Those who wish for convenient digests of the subject for practical as well as scientific purposes will find it usefully noticed in Neumann's 'Parasites, and Parasitic Diseases of Animals,' translated and edited by Dr. Fleming, pp. 36–38; and also with life-histories, &c., of some of the special stock infestations, in Dr. Taschenberg's 'Praktische Insekten-Kunde,' pt. iv. pp. 168–173; as well as in standard works on entomology or economic entomology too numerous to quote, but of some of which I give the titles in the list appended under the heading of "Bibliographical References" (immediately preceding the Index).

To these should be added reference to the work of M. Léon Dufour,

* Réaumur, *loc. cit.* p. 580.

† For above references see 'Classification of Insects,' by Prof. J. O. Westwood, vol. ii. pp. 580–587; and 'Die Fortpflanzung und Entwicklung der Pupiparen nach Beobachtung an *Melophagus ovinus*,' von Dr. Rud. Leuckart. Halle.

‡ 'Fauna Austriaca: die Fliegen,' by Dr. J. R. Schiner (Fam. Hippoboscidæ), vol. ii. p. 644.

published in 1845,* embodying his own minute observations of organisation, and more especially visceral organisation, of the *Pupipara* as especially studied by him in the *Hippobosca equina* (Forest Fly), the *Melophagus ovinus* (Sheep Tick or Spider Fly), and also the *Ornithomyia viridis* (Bird Spider Fly). In the latter part of this treatise (pp. 73–93) M. Dufour enters on minute detail of structure and embryological conditions relatively to method of propagation, which he considered to prove that from the first dawn of existence neither egg nor larva was to be found, but that the early development and method of nutrition resembled that of the Mammalia. Therefore he considered that, instead of the usual entomological terms for the stages of life preceding the pupal states, it would be more correct to use the words "embryo" and "fœtus."

This view of development attracted great attention at the time, and likewise contradiction; but those who care to go into the subject will find much of what may be called *useful straightforward* information regarding both external and internal structure of the three species of *Pupipara* above referred to, in the earlier pages of the treatise. And to those who care to study his minute embryological descriptions, accompanying them with perusal of Leuckart's quarto as a commentary on the points in which he considered Dufour was in error,—and also how in the main point on which Dufour based his view of mammalian development this eminent entomologist was correct as to what he saw, but wrong in what he considered the structure to be,—the study of the latter part of the treatise will be of considerable interest.

From the interest that was excited temporarily in this country regarding the habits of the Forest Fly, attention was directed to it (very much through correspondence published in our journals the 'Field' and the 'Veterinary Record') elsewhere, of which some notes may be of use in connection with what may be called "our own" species in other countries, or species belonging to other countries, of which one kind at least, the *H. canina*, especially infesting dogs, and found in some parts of Europe, may possibly (if attention was directed to the subject) be found present with us.

Hippobosca equina in the Canary Islands.—On the 29th of August I was favoured by Mr. A. H. Bechérvaise, writing from Santa Cruz, Teneriffe, Canary Islands, with the following letter, specimens being despatched accompanying:—"Having read your letter in the 'Field' of the 10th inst., I am sending you to-day a small box containing some

* 'Etudes anatomiques et physiologiques sur les Insectes Diptères de la famille des Pupipares,' par M. Léon Dufour ('Annales des Sciences Naturelles,' 3 me Sér. tome iii., Janvier, 1845.)

specimens found on horses and pigeons, respectively, in this island. The natives say that the same fly attacks both animals, but this I am inclined to doubt. Parasitical insects of many kinds are very abundant in these islands."—(A. H. B.)

On examination of the plentiful supply of specimens forwarded, those from the horse proved to be similar to our Forest Fly, that is to say, *Hippobosca equina*, Linn., of which Prof. Rondani observes that it not only infests horses, cattle, dogs, and other animals, in all parts of Europe, but that he has noticed specimens in the City Museum of Genoa and the Bellardi collections which were found in Africa and in the Canary Islands.*

With the Forest Flies were three puparia, of which Mr. Bechérvaise noted that the egg-like bodies "were deposited by these flies shortly after being placed in the bottle." These were the size and shape of the puparium figured at p. 95. One was still unchanged from the white colour with dark emarginate extremity of the puparia just after deposit; the two others had partially gained the brown colour.

Specimens of two other distinct species of *Hippobosca*—that is, of what we call in this country Forest Flies or Spider Flies—were sent me from British India. One of these kinds was forwarded as infesting dogs in the district of Cachar (Province of Assam, Further India); the other kind forwarded from Calcutta as common in Bengal, and, although found upon the dog, yet (like our own English Forest Flies) much more prevalent on the horse.

Dog Forest Fly or Spider Fly. *Hippobosca canina*, Rondani.

This species is stated by Prof. Camillo Rondani to be very similar to *Hippobosca equina*, Linn.,† and very easily confused with it, but distinguishable amongst other characteristics by its smaller size, paler colouring, and likewise the *scutellum* (the small transverse portion of the fore body immediately preceding the abdomen) being wholly above of an ivory-white colour, *not* rusty or rusty-red at the sides, but the central parts with a yellowish-white tinge. The veins of the wings of a reddish, *not* black tint.‡

* 'Muscaria Exotica Musei Civici Januensis.' Observata et distincta a Prof. Camillo Rondani. Fragmentum iv. p. 164 (separate impression, p. 15). Estratto dagli Annali del Mus. Civ. di Sc. Nat. di Genova, vol. xii. 29, 30, Marzo, 1878.

† For description of *H. equina* see p. 97.

‡ For scientific investigation I add the distinguishing characteristics verbatim as given by Prof. Rondani:—

"*H. canina*, Rondn.—Sp. similis equinæ Lin. et cum eadem facilius confundenda, sed distincta, statura minore, pictura pallidiore, et precipue colore scutelli,

The above characteristics were very noticeable in the Cachar specimens; the length of the flies from head to tip of wings folded as when at rest averaged about one-sixth less than that of our Forest Flies; ground colour of the body was paler and consequently less distinct from the spots than in our Forest Fly; and the difference of the *whole* of the upper part of the scutellum being white or whitish was very observable. The veins of the wings also were redder, but as there is some difference in depth of tint of these veins in our own *H. equina*, this distinction was not so marked.

The first observation of this fly sent in the past season was published in the 'Field' for August 3rd, 1895, p. 219; to which journal I acknowledge, with thanks, my obligation for the following good information:—

"The description and illustration of the Forest Fly contained in your paper of May 11th correspond almost exactly with a fly which is a parasite on the pariah dogs of the district of India in which I reside. I have often seen fifty or a hundred on the neck and chest of pariahs, and from these they find their way to European dogs, but trouble these to a lesser extent, being dispersed in the daily washings.

"They are pupiparous, and I have found their grub enclosed in a sac * in the long hair on the neck of my collie. They have the sidling motion and short flight of the Forest Fly, and the dogs find it almost impossible to get rid of one, such is the power of grasp of their hooked knife-like claws.

"I have often amused myself by grasping the fly by the wings between finger and thumb, then allowing it to catch the hair on the back of my other hand. So sharp is the claw, that the hair grasped by it is cut to shavings, like wood by a carpenter's plane. This is not noted in the letter of May 11th, where its power of raising the skin by its hold on the hair is mentioned, so I presume the fly I am describing has its knife-like claws sharper than those of the Forest Fly.

"A dog cannot kill one, the skin is so hard, but 'mouths' it with evident disgust, saliva flowing freely. The fly always escapes out of

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et partium oris. Illud in nostra sp. totum superne albicante sub-eburneum, non ad latera ferrugineum nec rufo-testaceum, macula tantum centrale flavido-albicante. Organo vero suctoria rufescentia vel lutescentia non nigricantia nec fusco picea; præterea vitta frontalis pallide rufa non obscure fusca; venæ alarum dilute testacea non nigricantes," &c.

"In tota Italia et in Europa saltem australe legitur cum sequente" [*H. equina*, E. A. O.] "permixta mammalibus variis molesta, et minus raro in canibus; sed examplaria speciei observavi Musei Civici Januensis in Persia lecta a March. J. Doria, et specimina collectionis Bellardi in Africa australe, et orientale inventa."—'Muscaria Exotica,' &c. (reference given p. 111).

* This "sac" will no doubt be the puparium (described previously, and figured at p. 95) containing the undeveloped fly.—Ed.

the mouth by the upper lip, and makes its way back to the hair of the neck. The flies are never seen on any other animals than dogs."—(J. B. D., Cachar, India, July 4th, 1895.)

The above remarks, it will be seen, embody a good deal of serviceably interesting information. For one thing, the still more easterly Asiatic locality beyond that of Persia, where the species was found by March. A. Doria; also the kind being only noticed in Cachar on dogs, and more especially on dogs of very neglected coats, notably the pariahs; and further the great power of the claws in so holding as to strip the hair so grasped into shavings.

Consequently on the insertion of the above letter in the 'Field,' some communication on the subject took place in India, during which I was favoured with the consignment of specimens mentioned above for identification, and once again the writer mentioned, "The fly is only found in dogs, especially pariahs" (J. B. D.). As the writer in his published communications has preferred only to use his initials, I have not thought myself at liberty to do otherwise.

In Prof. Rondani's notes of geographical locality (quoted pp. 111, 112), he mentions this *H. canina* being found throughout Italy, and in Europe at least in the southern parts, on various animals, "together with the *H. equina*"; and though a tropical or South European insect is not likely to establish itself here, still, in the great amount of transmission of animals at the present day, we may find the species present as an occasional pest, and therefore I mention it.

Indian or **Spotted Forest Fly.** *Hippobosca maculata*, Leach; *H. ægyptiaca*, Macquart (of Rondani).*

On the 4th of July I was favoured by Dr. Spooner Hart, of Calcutta (of the firm of Messrs. R. S. Hart Bros., Veterinary Surgeons to the Viceroy and Governor-General of India), with the following communication on the subject of what proved to be, to use its most generally known name, the Indian Forest Fly, *H. maculata*, Leach; this letter,

* The specimens of Indian Forest Fly sent me agreed, excepting in being of a deeper ground colour, with a type specimen of *H. ægyptiaca*, Macq., identified as such by Prof. Rondani, and kindly presented me from the Museo Civico di Genova; also they agree with the characteristic distinctions of this species given by Prof. Rondani in his 'Muscaria Exotica,' previously quoted. As, however, the *insufficient* description and figure of *ægyptiaca* given by Macquart in his Dipt. Exot. ii. p. 274, tab. 36, fig. 5 (1843), do not coincide with the specimens, it seems best, though I have given the synonym as above, only to use Leach's specific appellation of *maculata* here, as, besides not involving any possible confusion, it has the right of priority. I have to express my obligation to Mr. O. E. Janson, F.E.S., for being good enough to compare specimens of which I had not types with those in the British Museum, and also lending me various publications not now purchasable.—E. A. O.

and others subsequently sent me by Dr. Hart, giving a great deal of information useful in itself, and also for comparison regarding habits of other kinds of *Hippobosca*. After remarking that he wrote in consequence of reading a communication by myself on the *H. equina* published in the 'Veterinary Record,' Dr. Hart observed:—

"I am sending you by this mail some specimens of flies which strike me as being of the same family. They are common in Bengal and in other parts of India. The description you give of the habits of the fly, and likewise that given by Morgan Evans in the 'Field,' agree precisely with the flies which I am sending.

"The flies live upon the horse principally between the thighs, along the perinæum and under the tail. Some horses are driven mad even by the presence of a single fly, and in driving along not unfrequently start kicking most violently, kicking over the traces and shafts, and frequently running away with the carriage. In fact, so terrified do they become in many instances, that it is imperative to take them out of harness and lead them home.

"In other instances you will see horses standing perfectly tranquil with perhaps twenty or thirty flies crawling about between the thighs, and others with their heads buried in the skin, and from which position they are detached with difficulty.

"The fly, notwithstanding its powers of flight appear limited, is troublesome to catch, and killed with difficulty. Our syces (grooms) invariably pull the head off the fly, and then throw it away, but this does not stop it from crawling along.

"The fly frequently gets on the dog and buries itself in the hair chiefly along the back of the neck, but it never appears quite so happy and at home on a dog as upon a horse.

"Morgan Evans says 'it seems fond of taking short flights over the body in quick rushes, generally sideways like a crab, and at angles,' and this is perfectly true."—(S. H.)

These flies proved to be of the species originally named by Leach as the *H. maculata*, a very good and descriptive name, as the great number of little bright yellow patches, or spots, on the dark pitchy or black back are noticeable at a glance, and may well claim for it the name of the "Spotted" Forest Fly. Examined by the side of our own Forest Fly, the *H. equina*, it appears as generally slightly larger, and broader made. The back of the fore body is also much more varied in surface, the depth and curving of the depressions giving the more convex portions between them almost the appearance of lobes. The yellow spots, though at the first glance they seem irregular, in the specimens before me are arranged to some degree thus: one spot just at the back of the neck; on the shoulder a somewhat circular broken ring or square formed of one concave patch in front, and two concave

patches confluent at the inner tips behind; along the centre of the thorax is a short thin yellow line spreading out into a patch on each side so as to form a kind of anchor mark, and behind this anchor mark is a row of patches, three or five in number, according to the centre group being more or less confluent; besides these there are various side patches. The scutellum is of the deep pitchy or black colour of the thorax, marked across from back to front with three yellow patches, the centre one being much the largest.

The above are some of the main characteristics of this species which may be distinguished with a fairly strong hand-magnifier. For those who wish to go into the scientific differentiation I subjoin the original description from the 'Memoirs of the Wernerian Natural History Society.' Characteristic differences of the nervures of the wings from those of other species will be found in Prof. Rondani's work, previously quoted, attached to the description given by him under the synonym of *ægyptiaca*.*

Continuing now the observations of Dr. Spooner Hart, of Calcutta, on September 20th he favoured me with some further remarks on the Spotted Indian Forest Fly, the *H. maculata*, relatively to the presence of this kind on dogs, and the power and structure of its claws; likewise some observations on Ticks, which I give separately further on under this heading.

Dr. Hart remarked:—"You will remember I mentioned that the fly visited the dog, but did not appear to revel upon it, or was not so much at home upon it as upon the horse; and, speaking of Calcutta and other parts of Bengal, I have never seen the fly in such large numbers upon the dog as upon the horse; in fact, you seldom see more than one at a time upon the dog, whereas, as already stated, they may exist in large numbers upon the horse.

"My Forest Fly on the dog gets into the ears, or buries itself in

* *Hippobosca maculata*, Leach, tab. 26, fig. 11–13.—*Hippobosca equina* ex India Orientali. Fab. Syst. Ant. 338, lin. 9. *Habitat* in India Orientali haud infrequens. Mus. Dom. Francillon, Marsham, MacLeay, Leach. Caput flavum: oculi piceo-nigricantes: labium pallidè flavum: haustellum nigrum; vagina nigro-atra pilis canescentibus vestita: frons flava; medio latè exarato obscuriore: clypeus politus flavus, medio tenuiter sulcato; margine pallido-brunneo; anticè acutè emarginatus; laciniis parùm divaricatis subtruncatis, posticè subrotundatus tenuiter emarginatus. *Thorax* piceus flavo-maculatus irregulariter profundiùs-strigosus, striis sæpe confluentibus quasi crenulatis: scutellum nigricans aut intensè nigro-piceum maculis tribus flavis transversè dispositis, mediâ majore, margine postico albo-ciliato: pectus nigro-piceum transversim strigosum: alæ anticè inter pterigostea hyalinæ, posticè obscuræ pterigostea picea basi flava: pedes fusco-lutescentes pallidè villosuli; anteriores immaculati; quatuor postici apice tibiarum annulisque femorum nigris; tibiis posterioribus medio nigris; tarsi picei; ungues atri. *Abdomen* pilis cinerascentibus velutinum; lateribus sæpe nudis luteo-fuscis.—Leach, 'Memoirs of the Wernerian Natural History Society,' vol. ii. p. 553 (1818).

the hair at the back of the neck in preference to other parts, and there it remains motionless, and apparently engaged with its head in contact with the skin, and its tail just peeping out through the hairs. It appears very stupid, and is with difficulty dislodged, and will leave the spot reluctantly when disturbed, and return to it again. Some dogs detest the fly, and get excited on its approach, whilst others take but little notice of it, and this is especially the case with pariahs or common dogs."

The above notes of amount of infestation as noticed respectively on horses and on dogs refer, it will be observed, to the "Spotted" Indian kind, the *H. maculata*, regarding which Dr. Spooner Hart was writing; this, like our *equina*, appears to be especially the pest of horses, whilst the Cachar kind, the *canina*, though not limited to dogs, appears somewhat to prefer them.

The tearing and grasping apparatus with which the foot of the Indian Forest Fly is furnished appears to be quite as effective as that of our British species, as will be seen by turning to the figure of a claw of the *maculata* (at p. 99) showing the file-like side furrows and saw-edge.

Looking at some of the chief points of distinction between the three foregoing kinds of Forest Fly, it would appear that for general purposes they might be pretty surely known one from the other as follows:—

The *H. canina*, or Dog Forest Fly, smaller than either of the two other kinds, paler, and the *whole of the upper surface of the scutellum whitish*.

The *H. equina*, or Forest Fly (of this country), is of various shades of pitchy, with yellow marks on the fore body, and the *scutellum is dark, with one large central pale patch*.

The *H. maculata*, the Indian Forest Fly, is pitchy or blackish, with many yellow spots on the fore body, and the *scutellum is pitchy or blackish, with three pale spots, the central spot being much the largest*.

The considerations of prevention and remedy turn not only on use of applications to deter attack, and of treatment by which infestation when present can be got rid of, but also on such management of horses unused to the attack (when brought to an infested locality) as may make them acquainted with it without more danger or disturbance than can be helped.

Notes from various residents in the New Forest and its neighbourhood as to applications known to be of practical service, and regularly used in that especially infested locality, are given in the foregoing pages, especially at pp. 103 and 105, in the contributions of Mr. Gibb,

and of Mr. Goodall, F.R.C.V.S., to whom I am greatly obliged for being allowed to publish such useful information.

In a communication sent me by Dr. Spooner Hart, of Calcutta, relatively both to Forest and Gad Flies, he mentioned:—"We find sponging the legs and bodies of horses over with weak phenyle-water very effectual in keeping flies off."

An application much mentioned in works of Continental entomology is a decoction of walnut leaves in vinegar; and in Dr. Fleming's translation of Neumann's 'Parasites, and Parasitic Diseases of Animals,' p. 39, it is mentioned that in many countries, as a preventive of fly attacks, "use is frequently made of a decoction of walnut leaves, or a maceration of them in vinegar. This need only be applied to the skin once a week. Sometimes it is sufficient to merely rub the animals with the walnut-tree leaves."

Anything that is poisonous to the flies, as, for instance, tobacco-water, if such application could be used without risk to the health of the infested animals, would be of service; or applications of soap, particularly with a little mineral oil in it, which would not only be deterrent by their smell, but also prevent the flies using their wonderfully elaborate foot structure with anything like completeness. The greasy state of the hairs would effectually prevent the file- and saw-apparatus of the curved claws having the hold by which each fly is enabled to devote six pairs of excellently adapted flat forceps to powerful and painful dragging at the hairs to which they are applied; also the greasy matter would greatly prevent all action of the lesser appendages, as the bearded hair, and the expanded membrane, and bulb.

In the publications of the United States Board of Agriculture, kerosene emulsion is most strongly recommended as a trustworthy remedy for presence of "Ticks," and this mixture, or any mixture of soft-soap and mineral oil, if not too strong for safe use, appears to unite many of the points needed for remedial or preventive service.

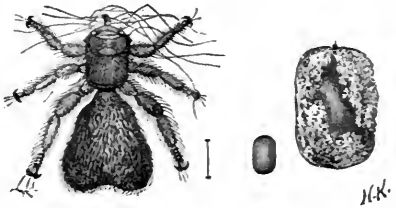
The importance of all the measures of cleanliness so strongly advocated is obvious from the habits of the flies. From it being their nature to harbour in the coats of the infested horses or other animals, and when disturbed, for the most part, only to take short flights and return for comfortable harbourage, these special pests lie to an unusual extent under our power, and all such treatment as brushing, combing, or other means which will clear them (and also making sure they are killed in the clearing), cannot fail to do good. Care should also be given to clearing out the puparia, or little egg-like bodies (see figure, p. 95), which at first are white, afterwards turn to deep brown or black, from which otherwise flies would presently come out.

The observations at pp. 111—116 regarding the habits of the Dog Forest Fly in Cachar, and those of the Indian Forest Fly when on

dogs, are well worth observation regarding the value of clean coats as preventives. It will be seen there that the infestation is especially found on the wild dogs, the pariahs, which are obviously animals of altogether neglected condition of coat, whilst the cared-for dogs, which are washed daily, are almost free. Also it is noted that down the ears and about the back of the neck, localities not well exposed to clearance of pests by the animal itself, are amongst the places on the dog where the fly chiefly establishes itself.

The above and other serviceable points will be found entered on in the foregoing observations. I much desire to add, lest the subject of *Hippobosca*, or Forest Fly, attack should appear entered on here at undue length, that this is partly on account of it being an infestation which has rarely been much entered on in this country. Partly also because I found in the course of my investigations that the literature of the subject was so little known of generally, and with regard to the great standard works so difficult to procure, and so costly, as to be very far from practically available; and, thirdly, such good assistance was kindly rendered me in the researches, that I have endeavoured to the very best of my power to present the information in a connected form, hoping it may be found of use, and also, and very particularly, that it may lead to further observation.

Sheep Spider Fly or "**Sheep Tick.**" *Melophagus ovinus*, Linn.



MELOPHAGUS OVINUS and puparium, nat. size and magnified (puparium showing dried adhesive coating).

The Sheep Spider Fly, or "Louse Fly," or "Sheep Tick," as it is commonly called, is an infestation closely resembling that of the Forest Fly, both in its method of propagation and its habits. It only lives actively in fly state, and multiplies, not by egg-laying or deposit of ordinary maggots, but by deposit, or laying, of squarish bright chestnut-coloured pupa-cases, from which the flies presently emerge, and feed by blood-sucking.

The infestation is not so troublesome in some respects as that of Forest Fly, for the "Sheep Ticks" have not the power of running as fast as they can go, backwards, forwards, or sidelong, scraping and dragging amongst the fine hair, and on the tenderest parts of the skin, but, on the contrary, move slowly and quietly in the wool. Also, as these Spider Flies are *wingless*, there is no alarm given by sudden attack and burrowing in the hair, neither can the infestation be spread except by the flies crawling from one animal to another, as for instance from sheep to lambs, or to the animals lying on pasturage where the chrysalids or pupa-cases have dropped from the sheep, and the flies crawl to them on hatching.

In the course of last season such a good supply of live specimens was sent me, in wool from fleeces of sheep that had not been dipped, as to enable me to study them and their peculiar chrysalis-case personally; and though with this attack the requisite treatment is so thoroughly known that any suggestions are quite uncalled for, some short notes of the life-history of the fly itself may be of interest.

It should perhaps be observed that, though the name of "Sheep Tick" is so commonly and universally bestowed on the pest, at least in Europe and America, as well as in this country, it may be said to be the established name, still, really, it is not a "Tick" at all. The difference may be easily told by noticing that, except in its very earliest state, a true Tick has *eight* legs, and also it has no marked division between the fore body and abdomen (see figures of "Ticks").

The Sheep Spider Flies, or "Sheep Ticks," scientifically *Melo-*

phagus ovinus, are wingless, somewhat flat in shape, and leathery in texture, bristly, especially on the abdomen and legs, and of a brownish colour, varying in tint on different parts of the body and legs, and more or less tinged with grey on the abdomen. When seen in the wool they greatly resemble small spiders.

The head is squarish, rather wider than the thorax, in which it is partially sunk, and is furnished with a long proboscis; the eyes are remarkably small; the ocelli, or simple eyes, wanting; and the antennæ, or horns, which are very short and sunk in pits, are wart-shaped at the ends.

The thorax, as seen from above, is square and without wings, and, so far as observable, also without poisers. The abdomen is much contracted at the base, then enlarged into a flattish bag-shape, and more or less concave at the tail extremity. The feet, like those of the Forest Fly (*H. equina*), are terminated by a pair of strong black curved claws, each furnished with a much shorter and lumpy, or somewhat thumb-like, side claw, and a bearded bristle or feather-like appendage—of the same nature as the "bearded hair" of the Forest Fly's foot (figured and described in the foregoing paper), but much shorter, and broader in proportion, and the plumes of the feather, or hairs of the bristle, more definitely arranged on each side of the centre—is very observable.

Two good figures of this process are given by Dr. Cooper Curtice in plate iv. of his 'Animal Parasites of Sheep,' of which one shows the foot "with the two claws, between which hangs the pinniform prehensile organ"; also "the tarsi, whose last joint supports the prehensile organ"; this magnified sufficiently to show the structure. The other figure, magnified sixty times, shows the prehensile organ separately in greater detail—that is, the segmented muscular portion included within the tarsus, and the feather-like "flexible grasping portion." *

The lower edge of the curved claw is notched below in the same manner as that of the *H. equina* and *H. maculata*, but, as far as I find, not so markedly. The teeth, so to call them, are rounder and shallower, and I could not certainly distinguish the file-like side markings. Possibly, however, this might be from not examining into this part of the structure until the specimens had dried.

These flies belong to the division of the *Pupipara*. The maggot is hatched within the mother fly from an egg, according to Leuckart, long and slender, varying from one millimètre and a half to slightly more in length, and rather more than half a millimètre in

* 'The Animal Parasites of Sheep,' by Cooper Curtice, D.V.S., M.D. United States Department of Agriculture. Washington: Government Printing Office. 1890. (Paper on "Sheep Ticks," pp. 39–44.)

breadth,* and within the parent fly the maggot feeds until it is full-grown, when it is deposited in a pupa-case. These "puparia" are not little round balls notched at one end like the pupa-cases of the Forest Fly, but flatter from back to front, and very bluntly oval in shape, with the two ends truncated, so as to be almost of a long-square shape, with the four corners rounded off.

Also the colour is different. The Sheep Tick chrysalis-cases are of a clear bright chestnut, where they can be seen, but this is commonly more or less hidden by an incrustation of dried matter, which has to be cleaned off in order to see the smooth bright coat beneath.† In my own specimen (figured from life) it will be seen that about a third only of the surface was clean. In the excellent paper by Dr. Cooper Curtice on Sheep, published by the U.S.A. Department of Agriculture (quoted above), he mentions, regarding deposit of these puparia by the Sheep Tick, and the nature of the incrustation, that "they only lay one at a time in the wool. A portion of each puparium will be found to be covered with a dry dark substance, which came from the parent when the puparium was laid, was sticky, and glued it to the surrounding hairs. This prevents the pupa, which becomes dry, hard, and glassy, from falling from the wool." ‡

How many of these egg-like chrysalis-cases may be produced by one fly does not seem certain. Dr. Taschenberg mentions that successively—that is, from time to time—and taking the number of single deposits altogether, as many as eight puparia may be produced by one Spider Fly.

In due course the fly matures, and escapes from the case by cracking it across near one end. The only note I am aware of as to the time taken for development, is that of within four weeks at ordinary temperatures, given by Dr. Curtice from his own observations.

Very few attacks lie so completely under cure by treatment as this. It is most especially a sheep attack, though the flies have existed for a time on human blood, and they die soon if deprived of food. In the case of some scores sent me in wool from sheep which *had not been dipped*, though all circumstances excepting that of presence of food were comfortable for them, they died in a very few days.

The treatment, which appears to do all that is needed in the way of application both here and in the States, is the use of dips. On this point Prof. Wallace notes, in his 'Farm Live Stock,' speaking of these Sheep Ticks (known in Scotland under the name of Kades or Keds),

* See 'Die Fortpflanzung und Entwicklung der Pupiparen nach Beobachtungen an *Melophagus ovinus*,' von Dr. Rud. Leuckart, p. 17. Halle, 1858.

† See 'Etudes Anatomiques et Physiologiques sur les Insectes Diptères de la famille des Pupipares,' by M. Léon Dufour, p. 84. (Previously quoted.)

‡ 'Animal Parasites' (before referred to), p. 40.

"They may be kept very much under by timely dipping, if not got rid of altogether." *

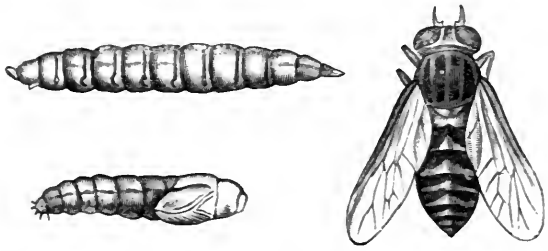
The different kinds of washes and dips, as also the time for application in reference to conditions of sheep, as well as circumstances of shearing time, repetition of dipping in order wholly to clear infestation, and all details, are so thoroughly understood by all interested in the subject, that it would be mere presumption on my part to say anything regarding treatment. But perhaps I may venture to draw attention to the book by Dr. Cooper Curtice, previously alluded to, published under the direction of the Secretary of Agriculture, U.S.A. It contains a great amount of serviceable information on internal and external parasites of the sheep most clearly given, embodying both the nature of the attacks in scientific detail, yet intelligibly to all, and likewise the treatment found to answer; each or almost every paper being accompanied by a full-sized good plate. It would be easily procurable, by order, from Messrs. William Wesley & Son (Agency of the United States Government Departments), 28, Essex Street, Strand, London, W.C. The title, put shortly, is as follows :—

Curtice (C.), 'The Animal Parasites of Sheep.' With Thirty-six partly Coloured Plates. Large 8vo, cloth. Washington, 1890. 12s.

* 'Farm Live Stock of Great Britain,' by Robert Wallace, F.L.S., &c., Professor of Agriculture in the University of Edinburgh, p. 273.

TABANIDÆ.—Gad Flies, Horse Flies, or Breeze Flies.

Hæmatopota pluvialis, Linn., Horse or Rain Breeze Fly.
Therioplectes tropicus, Meig. (no known English name).
,, *solstitialis*, Meig., Midsummer Gad Fly.
Atylotus fulvus, Meig., Tawny Gad Fly.
Tabanus bovinus, Linn.,* Great Ox Gad Fly.
,, *autumnalis*, Linn., Autumn Gad Fly.
,, *bromius*, Linn., "Noisy" Breeze Fly.
,, *cognatus*, Löw, "Allied" Breeze Fly.
Chrysops cæcutiens, Linn., Blinding Breeze Fly.



TABANUS BOVINUS, Linn., larva and pupa, life size. After De Geer.

In the course of the attention which was directed during the past season to the presence of horse and cattle flies in the New Forest, some twelve or fourteen different kinds of what we commonly know as "Gad Flies," "Horse Flies," or "Breeze Flies," were sent me, with requests for the precise name. Some of the kinds were perfectly easily distinguishable, for all practical purposes, under their common names, as, for instance, the Great Ox Gad Fly, or the little straight-sided grey "Horse Fly," or, again, the pretty little *Chrysops*, with its banded wings; but with regard to the scientific names, all who are at all acquainted with the subject will know the impossibility of any but an expert giving a really trustworthy identification.

Therefore, after identifying to the best of my power from the living, or still fresh specimens sent me, I submitted samples to our eminent authority on these subjects, Mr. R. H. Meade, of Bradford,

* For observations on differences between *Tabanus sudeticus* as separated by Zeller from *T. bovinus*, Linn., see p. 127; but as the distinctions are quite indistinguishable except by experts, and these notes are meant for agricultural service, in which both kinds are well known as the Great Ox Gad Fly, I have retained the name of *bovinus*, with requisite explanation.—E. A. O.

who was good enough to verify my identifications, and in the above list I give the names of the kinds sent which are most easily recognized without great research. I am also greatly indebted to Prof. J. Mik, of Vienna, for being good enough to present me with a small type collection of Tabanidæ, a truly invaluable help from such a skilled donor.

The family of the Tabanidæ, commonly known as Gad Flies, Horse Flies, Breeze Flies, &c., are strong and mostly broad-made flies, varying in size in this country from about or little more than a quarter of an inch, to an inch or more in length, and from three-quarters of an inch to one or two inches in spread of the wings.

They are especially distinguishable by the formation of the mouth parts: the proboscis is short, and projects horizontally, and in the female encloses six, and in the male four, somewhat lancet-like instruments. It is terminated by two fleshy lip-like lobes, and is guarded at the sides by the maxillary palpi, which are large and two-jointed. The females only are blood-suckers; in the males the mouth parts are less adapted for piercing, and they live on the sweet matter in flowers, or on "sweet sap."

The compound eyes are very large, and often, especially in the males, nearly cover the head, and are frequently gaily patterned (whilst living) with spots or stripes of bright colours. The third joint of the antennæ is large, and often with such a decided notch as to give a tooth-like projection (see figure, p. 123). The simple eyes (ocelli) are said to be usually absent, or almost obsolete, though sometimes, as in *Chrysops*, three are present (*vide* Schiner).

The thorax is compact and thick, with hinder portion (scutellum) much developed. The wings rather deflexed, or laid flat, and with many veins; when at rest usually not laid over each other, but about a quarter or half open, or extended horizontally. The "alulets," or winglets (an enlargement of the membrane at the lower part of the hinder edge of the wing), large. The abdomen seven-ringed. The legs stout.

The figure of the Great Ox Gad Fly at p. 123 gives a fair idea of the above details so far as they can be shown without being much magnified.

The grubs (larvæ) do not live in or on the hides of horses or other animals, but those of the genus *Tabanus* (Schiner), which includes many kinds, live in damp earth or sand, or under decaying leaves and stems in damp places, and the grub of *T. tropicus* has been found to feed under ground in damp woods, from whence the flies greatly torment the horses in neighbouring meadows.* The grubs of the

* See 'Exposition of English Insects,' by Moses Harris, p. 28, MDCCLXXXII. An old work in which there are short but very careful descriptions of many of our English horse and cattle flies, accompanied by coloured figures.

Chrysops are stated also to live in earth. So far as they are described, the *Tabanus* grubs, are cylindrical, somewhat largest about the middle, and they turn to the pupal condition not within the maggot-skin, but free, something in the manner of the Daddy Longlegs, or *Tipula* larvæ.

In the 'Classification of Insects,' by the late Prof. Westwood, Life-President of our Entomological Society, he remarks: "We are indebted to De Geer for the knowledge we possess of the transformations of this family"; and as still up to the present time De Geer's account of his own personal observations of the changes of the *T. bovinus*, Linn., from larval state up to the perfect insect continues to be the chief source of information on the subject, and cannot be surpassed in accuracy or excellence of description, I give the main points in my own translation from his 'Mémoires,' believing that the history of the changes, told almost in his own words, will be much more usefully interesting than a mere abstract of the scientific points to be deduced from them.*

M. De Geer, after remarking that the larvæ of the Tabanidæ (of which no author had spoken before himself) live in the ground, observes:—

"I have found many in the month of May whilst searching in the earth of a meadow, and having shut up seven or eight in a box filled with fresh earth, which I was careful to renew from time to time, I observed on the 12th of June, 1760, that one of these larvæ had taken the form of a nymph" [what at the present day we call a chrysalis or pupa, E. A. O.], "and that it had half come out of the earth, keeping the head and fore part of the body out of the earth, whilst the rest was buried in it.

"I searched the earth in the box to find the other larvæ, but there were only three remaining, without counting that which had changed, and these three larvæ assumed afterward similarly the form of 'nymphs,'—similarly coming half out of the earth. . . . I found there also one small dead larva, and as the other larvæ which had disappeared could not have got out of the box, there is every appearance that they had been devoured by those which arrived at transformation.

"The largest larva which I have had of this kind was nearly an inch and a half long when extended as much as possible, and two lines and a half in breadth at the middle of the body. It much resembles those of the large Tipulæ" [what we know popularly as Crane Flies, or Daddy Longlegs, E. A. O.] "which live in the earth.

"It is cylindrical, of nearly equal thickness throughout, but lesser towards the head, so that the anterior portion is conical and pointed,

* See 'Mémoires pour servir à l'histoire des Insectes,' par M. le Baron Charles De Geer, p. 214. Tome sixième. Stockholm, 1776.

and the hinder part is also terminated in a cone, but much shorter than that of the fore part, It is divided into twelve rings, of which the terminal ring is nipple-shaped.

"The colour of the larva is of a dirty yellowish white, . . . with seven roughish or somewhat raised bands of a blackish colour placed on the fore part of the fourth, fifth, and following segments to the tenth inclusive, and which encircle the body like hoops. These same segments have towards the sides and at the lower part some fleshy tubercle-like projections, which the larva can withdraw into the body or push out again at pleasure." [By the help of this contraction and expansion, and the use of the head-hooks at the same time, the *footless* larva carries on its somewhat worm-like progression.—E. A. O.]

"The little head is brown and shining, of a lengthened shape, and has two small short antennæ, and two large hard hooks of the length of the head placed above, but curved downwards. . . . When at rest it withdraws the head into the first segment, and this into the second, and then the fore part of the body is as thick as the rest.

"The nymph" [pupa] "of this larva is nearly an inch long" [see figure, p. 123], "and of the same thickness as the maggot, and of almost equal thickness throughout, excepting the last ring of the body, which is smaller than the rest. It has in general the appearance of those of the larger Tipulæ. . . . The colour of this nymph is of a greyish brown, darker on the abdomen. This is divided into eight rings, each one having along the hinder edge a fringe of long grey hairs; the last ring is armed at the end with six hard and scaly points, which serve to push the nymph half out of the earth, according to its custom."—(C. De G.)

It was at the end of about a month, or a few days more, that the *Tabanus* fly quitted the pupal envelope, which split all along the upper part of the thorax ("*corcelet*"), opening similarly on each side of the head, which thus detaches itself from the rest, and leaves free exit for the perfect fly. The identical specimen which emerged, and proved to be the *Tabanus bovinus* of Linnæus and De Geer,* is figured in plate xii. of the 'Mémoires' of De Geer (referred to at p. 125); the various stages are figured at 6–14; the male *T. bovinus*, or Ox Gad Fly, at fig. 10, and the female at fig. 11, and from these figures my accompanying figure is precisely copied.

The above description, from an observer of such high standing, is of great value.

The *T. bovinus*, Linn., the Great Ox Gad Fly, is four-fifths of an inch or rather more in length, and the length of each wing is about

* See for description, 'Fauna Austriaca: die Fliegen' (Diptera), by J. Rudolph Schiner, vol. i. p. 34.

from three-fifths to three-fourths of an inch; the male is little if at all smaller than the female.

The male has greenish eyes of one colour (that is, not striped or spotted). The thorax (or fore body) black brown, upper side shining, with five indistinct greyish-yellow stripes, and short, thick, mixed, brownish-black and yellowish-grey hair. The wings hyaline, yellowish-grey, and especially yellow towards the fore edge, the veins there of a bright to yellow-brown. Hinder body reddish-yellow brown, having above a central stripe, and tip of a darker or blackish tint, with, always, a triangular yellowish, or a triangular pale milk-white spot in the middle of the hinder borders of the first to the fifth segment. The second to the fourth segment with fine and short light yellow-brown and whitish hair at the hinder edge. Abdomen beneath orange colour; the three last segments, and a central stripe along all the segments, black-brown or shining black, or entirely covered with yellowish-grey powder. Legs black-brown; tibia (shanks) more or less yellow-brown; tarsi pitch-brown.

The female differs in the one-coloured eyes being of a bright green, with a coppery glow. The thorax and its appendages like those of the male, only brighter, and more clearly striped with grey along the back. The abdomen flatter, and more rounded at the end, not so pointed as with the male, but similarly coloured and marked; the white triangles in the dorsal line variable in size, and reach in the second, third, and fourth segments the front edge. The under side of the abdomen as in the male, but mostly orange only as far as the fourth segment, or by the side of the central stripe brown-grey, or ash-grey; behind this entirely black-grey.*

The females are noted by Dr. Brauer as "swarming about horses, cattle, and deer; the males soaring in woodlands and on somewhat elevated meadow-ground near water, not at the summit of mountains, especially in close sultry weather, in sunshine after rain-storms, or in early morning."

The great size and the colouring of the above-described fine insects distinguish them perfectly from all other of our British Gad Flies, excepting the kind now separated from them under the scientific name of *Tabanus sudeticus*, of Zeller. This is to some degree distinguishable from the above by its larger size, the females being from just under to just over an inch in length. The eyes (without cross-bands) are *not* bright green or greenish as in *bovinus*, but blackish or blackish-brown, with a coppery glow, and the hinder body is only orange-coloured for

* For full description see "Die Zweiflügler des Kaiserlichen Museums zu Wien," von Prof. Dr. Friedrich Brauer, pp. 105–216 of 'Denkschriften der Kaiserlicher Akademie der Wissenschaften,' Zweiundvierzigster Band, Wien, 1880 (*i. e.* Transactions of the Imperial Academy of Sciences in Vienna, forty-second volume).

a short distance along the sides, the almost velvet-black colour predominating above. As in *bovinus*, there is a central row of spots; but when type specimens of the two kinds are examined side by side, the black ground colour of *sudeticus* catches the eye at once. Also it is considered to fly earlier in the year,—*sudeticus* in May and middle of June, *bovinus* end of June, July and August.

For specific differences see references below*; but though the insects are distinguishable by experts, they are not at all so without types and full description, inappropriate here; therefore, as the early name *T. bovinus*, Linn., includes both kinds scientifically, and the name of Great Ox Gad Fly does so for all practical purposes, I have preserved the comprehensive name still often used.

Of the other Gad Flies mentioned, the Autumnal Gad Fly, *Tabanus autumnalis*, is one of the most noticeable. This is a smaller and much greyer fly than the above, not quite four-fifths of an inch in length. Eyes very dark, black or part grey, without cross-bands. Thorax black-brown or grey above, with five grey stripes. The abdomen above of a greyish red-brown in the male, black in the female, in both male and female with three rows of white or white-grey spots. The central row triangular; the rows (one on each side of the central stripe) of oval, usually white, spots placed slantingly from the inner and foremost to the outer and hindmost end of each spot.

Autumnal Breeze Fly (after Railliet).

T. bromius, sometimes known as the Noisy Breeze Fly, is also of a greyish tint, but smaller than the above, being only about half an inch long; and the eyes with *one purple cross stripe*,—in the females on a green ground colour, with a reddish glance. Like *autumnalis*, this kind has five grey stripes along the thorax, but they are more noticeable; also there are three stripes along the abdomen, similarly of a central row of triangular spots, and two slanting side rows; in regular course the central row whitish, the side rows yellowish, and this, together with the side of some of the foremost segments in the male being more or less of an orange colour, and occasionally something of the same tint in the female, gives the fly a more greyish-yellow colour; also it is somewhat hairy.

* Brauer's 'Tabanidæ' (cited p. 127), pp. 184, 185. 'Dipterologische Beiträge,' von P. P. Zeller, in 'Isis,' p. 815, 2, plate i. fig. 5–8, 1842. 'Fauna Austriaca: die Fliegen' (Diptera), vol. i. p. 34. I may be permitted to add that in case any of my correspondents wish for information in more detail, I have Dr. Brauer's and Dr. Schiner's works above referred to in my own library. Prof. Zeller's work being only accessible with great difficulty, I have not the work itself, but large extracts and abstracts taken by myself from a copy kindly lent me by Mr. O. E. Janson, F.E.S., which I believe embody all requisite information.

T. cognatus, Löw (= *T. glaucopis*, Meigen).—Length three-fifths of an inch, or rather more. Eyes with two or three purple bands; ground colour partly grey and green in male, green in female. Thorax grey, bright black on the back, with five observable pale stripes. Abdomen may be generally described as black, with the hinder edges of the segments yellow, with a middle stripe, on each side of which is a stripe of spots of pale yellow. In the female the middle stripe formed of grey triangular spots. In the *cognatus*, noted by Brauer as probably only a variety of the above, the thorax is noted as of a darker grey, and the ground colour of the abdomen dark red-brown or chestnut-brown to the fifth segment; in the female the red-brown ground colour sometimes extends to the sides of the second segment observably, otherwise the segments black with smaller and greyer stripe along the centre, and pale yellow or orange isolated round side spots.

The specimen of the above species which I submitted to Mr. Meade as being (to the best of my power of identification) *glaucopis*, he noted he should rather conclude it to be *cognatus*, considered by Dr. Brauer to be only a variety of the *glaucopis* species, and I feel no doubt he is correct.

Sub-genus *Therioplectes: T. tropicus*, Meig.—Length averaging about three-fifths of an inch. Eyes of the male with fine and thick yellow-grey hair, three purple bands, and some green in the ground colour; of the female green, and also with three purple bands. Thorax black grey, with slightly observable stripes. Upper side of the abdomen with the first to the third segment orange, with nearly a third of the breadth of the segment occupied by a black dorsal stripe, the ground colour from the fourth to the last segment black.

Sub-genus *Atylotus: A. fulvus*, Meigen, "Tawny Breeze Fly," "Golden Yellow-felted and Orange-powdered kind."—Length slightly more than half an inch. Eyes of the male with thick and long yellow-grey hair, commonly without stripes; of female pale olive-green, with many black, round, bright points, and a fine sloping darker line. Thorax strikingly clothed with golden-yellow hairs. Abdomen with a dark stripe, yet of a general reddish-yellow colour, and the hair entirely of a golden colour. This species is easily distinguishable from the foregoing by its hairy or even felted appearance.

The above species are amongst the Diptera classed by Dr. Brauer and Dr. Schiner in the great division of the genus *Tabanus*, Linn., of which Dr. Schiner gives the general habits as follows:—"The larvæ live in damp earth, in sand, or beneath decaying leaves and stems in damp places. The flies are abundant on pastures, and by roads and paths, where they rest on stems of neighbouring trees, and on the look-out for horses and cattle, to which the blood-sucking females are very troublesome. The males also frequent flowers, or hover, especially

in the mornings and evenings in sunshine, over the roads."—(See Dr. Taschenberg's 'Fauna Austriaca: die Fliegen,' previously quoted, vol. ii. p. 29.)

Two other very troublesome kinds remain to be noticed amongst those sent me from the New Forest, of distinct genera from the above. One of these is the *Hæmatopota pluvialis*, Panz., known sometimes as the Small Rain Breeze Fly, or Horse Breeze Fly. This is a little somewhat straight-sided fly, not quite half an inch in length; the males blackish-grey; the females whitish-grey; and both sexes much covered with white hair. The eyes, when living, green above, purple below, with bluish stripes, or one-coloured, with stripes. The wings grey, and covered with pale markings, in the shape of very short narrow stripes, forming straight or curved lines, or even parts of broken circles in all directions; when at rest, the wings are placed like a roof over the abdomen. Of this species Dr. Taschenberg says:—"An extraordinarily troublesome Breeze Fly." Schiner notes the flies as numerous by roads and paths, and on hot days attacking the draught animals, especially horses. Also as being always at hand near water in the height of summer, and annoying bathers; and so persevering in their attacks that they can be seized by the fingers, without their flying away.

Small Rain Breeze Fly, magnified (after Railliet).

The early stages appear to be still unknown.

Genus *Chrysops: C. cæcutiens*, Linn., "Small Blinding Breeze Fly."—Has distinct ocelli—that is, little speck-like eyes on the top of

Small Blinding Breeze Fly, magnified (after Railliet).

the head—three in number; and the antennæ (horns) longer than the breadth of the head, without crescent-shaped side notch. Wings, when at rest, expanded to about half open (see figure). Length from a third to two-fifths of an inch. General colour black in the male, but browner in the female, with a yellow band across the upper side of the base of the abdomen, bearing in the middle a dark marking somewhat of the shape of a capital X, with the centre of the upper part (that is, the part nearest the fore body) entirely dark; sometimes (*vide* Schiner's

'Fliegen,' previously quoted) the male also has a similar mark on a yellow band. Eyes golden-green, with purple spots, and hind border or stripe. Wings in the male almost entirely black or blackish-brown; in the female somewhat lighter, or occasionally lighter, with two large pale spaces, dividing the dark part into three patches, one at the tip, a much larger one across the wing just beyond the centre, and a smaller one at the base, these being joined by dark colour along the fore edge of the wing.

Of this kind Dr. Schiner notes:—"Metamorphosis unknown; according to Fabricius they live in larval condition in the earth. The flies are often found near water in great numbers, and cause much annoyance to men and animals by their very persevering attacks. The two sexes are very different in their markings."—(Schiner, *op. cit.* vol. i. p. 40.)

On the 12th of May in the past year, in reply to some observations or enquiries of mine regarding prevalence of the Great Gad Fly in the New Forest, Mr. D. D. Gibb, of Ossemsley Manor Farm, near Lymington, Hants, to whom I was much indebted for information in the course of the investigations, favoured me with the following notes:—

"Your information as to the presence of the Great Gad Fly in the New Forest district is perfectly correct. Though not so plentiful as the Warble Fly, they are frequently too numerous to make themselves pleasant. I have seen a pair of horses, when at plough or harrowing in summer, have three or four of these flies upon them, you may guess with what result. Unless killed, horses become distracted by their blood-sucking propensities, and sometimes bolt with the plough at their heels. It is the combined attacks of these and other flies referred to which so terrify strange horses, and send cattle flying with tails in the air."

Some weeks later, on the 27th of June (after sending me specimens of various kinds of Gad Flies), Mr. Gibb mentioned:—

"Any number can be found similar to those sent. . . . Yesterday I observed starlings and wagtails following our cattle, and found they were catching Tabanidæ and other flies; the wagtails describing somersaults and other peculiar motions in their hunt. They are most invaluable birds as destroyers; I have seen them pursue their prey into the stable."

On the 6th of July Mr. Gibb sent me some further notes, which are interesting as showing the quantity in which the Tabanidæ appeared together with warm weather after rain, with some remarks as to relative amount of different kinds:—

"Yesterday and to-day the weather is very warm after the recent

rains, which have benefited us much after ten weeks' drought, consequently these flies are again very plentiful." Consequently Mr. Gibb was able to send me a further supply, with the observation:—"I believe they will be found to differ little from the last, except I have succeeded in capturing one specimen of *Tabanus borinus;* these flies are now plentiful, but are most difficult to catch.

"Another kind difficult to capture, although frequently seen, is the largest dark-spotted fly with grey markings." [*T. autumnalis.*—E. A. O.] "*H. pluvialis* is not very numerous compared with the other kinds. I have seen them in Scotland by thousands. *Chrysops* is now very busy and plentiful; by the specimens you will observe that they vary in colour."—(D. D. G.)

On the 20th of June Mr. Moens, of Tweed, Lymington, Hampshire, obliged me with specimens of Tabanidæ, of which three proved to be respectively the *Tabanus autumnalis*, the *Hæmatopota pluvialis*, and the *Chrysops cæcutiens* (see previous pages for descriptions), with the following remarks:—

"I am sending you specimens of four sorts of flies which (as they say) 'terrify' our animals in the New Forest, besides the regular Forest Fly. The larger ones go here by the name of 'Stoats'; . . . the fly with the speckled wings, and the smaller one, are termed blood-suckers; they gorge themselves with blood, which they draw readily from horses. These are especially prevalent this summer, and are most troublesome in the hot close weather preceding thunderstorms."—(W. M.)

On the 24th of June Mr. Moens gave me a few more notes. Of the *Chrysops cæcutiens* he mentioned:—"This fly causes the blood to run down the horse's neck when it is gorged. I will try to secure more specimens, and send them alive; but, though very plentiful, and the forest is full of them, one must take horses and nets to get them. It is curious how our forest ponies go on the top of the rising ground, where there is a breath of wind, 'to shade' themselves out in the full sun, for the flies don't like the wind, and are always most troublesome in sheltered places."—(W. M.)

In looking over the past year's observations, firstly, with regard to the number of species of Tabanidæ forwarded, it is of some interest to find so many kinds in such a small area. In the above lists it will be seen there were nine distinct species, and others were sent, amounting in all to about thirteen kinds, some of which I was not able o identify with absolute certainty. There is no doubt that the *Hippobosca*, or Forest Fly, is a cause of great danger and annoyance; but it is worth observation, though not much mentioned, that these Gad Flies also play a very powerful part in trouble caused.

So far as is known, especially regarding the part of the family

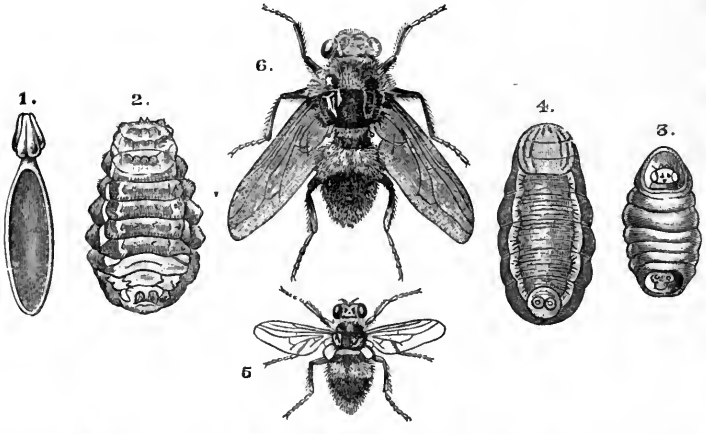
included in the genus *Tabanus*, the history appears to be that they pass their first stage of life as cylindrical grubs, very like those of the Daddy Longlegs (Tipulæ), and mostly in damp ground, decaying vegetable matter, and the like places; and when the time for the change to the chrysalis state arrives—this takes place much as with the Tipulæ before mentioned—casting off the outer larval skin, and completing development within a pellicle showing the limbs and shape of the forming insect, and from which it presently emerges by cracking open the skin, and leaving it remaining as it stood, partly fixed and upright in the ground.

There appears no possible way of getting rid of the insects (as in the case of other attacks) in larval condition, for we have no guide to where they may be lying in the woodland or damp locality.

The chief available means of prevention appear to be applications to the coats of the horses or cattle exposed to their attacks which may be obnoxious to the insects, and therefore deterrent. Some of these, like the application of weak phenyle, recommended by Dr. Spooner Hart, appear sure to be of service, and the remedies mentioned on the authority of Mr. T. B. Goodall, of Christchurch, and other residents in or near the Forest, could not fail also to be useful. Such measures of protection as nets, ear-caps, &c., to keep the insects to some degree from being able to get at the hide of the animals, are too well-known to need comment.

ŒSTRIDÆ.—Warble and Bot Flies.

Hypoderma diana, Brauer; Deer Warble Fly (Deer).
Cephenomyia rufibarbis, Meigen; Throat Bot Fly (Deer).
Hypoderma bovis, De Geer; Warble Fly (Ox).
Hypoderma lineata, Villers; Warble Fly (Ox).



HYPODERMA BOVIS.—1, egg; 2, maggot; 3 and 4, chrysalis-case; 5 and 6, fly; 3 and 5, nat. size, after Bracy Clark; the other figures after Brauer, and all magnified.

Early in the summer of the past year enquiry was sent me regarding warble presence in hides of deer, a matter on which, as it had never come under my notice practically, but only in reference to kinds of warble or other *Œstrus* flies injurious to deer, I was little able to offer information. As the subject, however, appeared to be of a good deal of interest, I obtained introductions to a few experienced superintendents and others, who, being personally interested in observation on a large scale of the condition of deer-hides, were fully qualified to give information regarding amount of infestation.

The notes I was favoured with showed, so far as they went, the *absence* of warble (that is, of the lumps caused by the great maggots of flies of the nature of the *Hypoderma bovis* so troublesome to cattle) on the fallow deer. Also some amount of infestation on the roe deer, but not enough to attract attention to it, excepting in collections of hides for business purposes. In the case of the red deer the warble attack was much more prevalent, so as to be noticeable as seriously injurious both to flesh and hides in forest observations, as well as to the pelts brought under examination for purposes of manufacture. This

especially with regard to Scottish red deer, and to some extent in the case of those from English parks, but not so badly as with the Scottish pelts.

It was also observed that the warble-perforations were of two sizes, those in the roe deer pelts being smaller than those in the red deer. This would appear to point to there being two kinds of Warble Fly present, and further observations on this point would be of useful interest, for, in what I believe is our most recent authoritative list of British Diptera* (two-winged flies), mention is only made of one species of these Deer Warble Flies as being present in Britain. This is the *Hypoderma diana*, of Brauer, and is known to attack the roe deer on the Continent; this species and also the *Hypoderma actæon* attack the red deer, but, so far as I am aware, we have no information as to what species of fly it is which causes the great damage (alluded to further on) by the great number of *small* perforations it causes in grub state, and this would be a useful as well as interesting point to learn.

In regard to fallow deer. — The following note is from Mr. Christopher Chouler, gamekeeper to His Grace the Duke of Buccleuch, at Dalkeith Park, Midlothian, whom I was recommended to apply to as about the best authority in Scotland on this subject. Mr. Chouler wrote:—"I may say that I have been at Dalkeith twenty-one years. At first the deer numbered nearly six hundred, latterly they have been considerably reduced, and during that time have never seen any troubled with warble, but have occasionally taken the maggot out of my cow, which grazes with the deer. I have never known the warble attack fallow deer, but I recollect once seeing a skin of the red deer much damaged by them."—(C. C.)

In reference to the roe deer, the following remarks, for which I am obliged to Mr. J. Bell (gamekeeper), Drumlanrig Park, Thornhill, Dumfries-shire, N.B., show the warble attack not to have been to an extent noticed in what hides came under observation locally, though from other notes taken from inspection of general collection of hides, warble attack is found to exist with us on the roe deer. Mr. Bell remarked:—"I will not go the length of saying that roe deer are not affected with warbles in Scotland, but I must confess that I never noticed it. I have also asked some of my assistants here, one man especially, who has skinned a very large number in his time, but they also say that they never saw it.

"Had my attention been called to this matter a few years ago, it could have been very easily investigated, as we had then a large number

* 'List of British Diptera,' by G. H. Verrall, Fellow of the Entomological Society. London, 1888.

of roe; but extensive young plantations having been planted, we had to put them down to a very small number, and now only an occasional one is killed. I shall, however, now pay attention to this, and should I ever find anything of the kind, I shall let you know.

"Roe deer skins are so valueless, that after a day's shooting two or three men were generally told off to get the skins off as quickly as possible, the carcases cut up, and distributed amongst the poor people. By this you can understand that there was not much notice taken of the skins."—(J. B.)

In regard to attack on red deer, I had a few remarks from Mr. Tom Speedy, from The Inch, Edinburgh, noting very observable injury from warble presence, and from Mr. Speedy's experience, his knowledge as a naturalist, and also as the author of several books on sport, he could probably, if his leisure and inclination allowed, give us much useful information on the subject.

Mr. Speedy observed:—"With regard to warbles in deer. They are quite common; but I have been under the impression (I have not made a study of them) that they attack deer more in those forests where there is a scarcity of food. Some years ago I shot a number of hinds on ground that marched with Mr. ——'s * forest, where they were overstocked, and they were practically useless through the skin and flesh being destroyed by warbles. The flesh looks nasty round the warble."—(T. S.)

Infestation in young red deer's hide.—On the 22nd of January of the present year (1896), I was favoured by Mr. T. Speedy, of 17, St. Andrew's Square, Edinburgh, with an excellent example of warble attack then in full action in the skin of a red deer. The animal was still obviously quite young, possibly not more than two years old, for the hide was only, as measured when laid flat (not drawn out or stretched), twenty-one inches in length, by ten and a half inches in breadth, and contained upwards of one hundred and sixty warble-cells. From some of these the maggots were escaping; and in many cases the pellicle of tissue covering the maggot-cell on the under surface of the hide was so thin that the dark markings on the maggots within were clearly noticeable through it.

The warble-cells were in many cases placed so close together that the swellings were confluent, these in groups of from two to six or more, forming patches of warble-blistered surface from an inch or an inch and a half across, up to a great patch of more than five inches in length by three and a quarter in breadth, which was almost completely covered by the blisters—that is, by the more or less worked-away pellicle of the under side of the hide raised into lumps by the presence of the warble grubs within.

* Name omitted for obvious reasons.

Of the fifty-five larvæ, or maggots, taken from the warbles, all but about three (which were more advanced in condition) might, I should consider, be very safely referred to the second stage of the larvæ of the *Hypoderma diana*, Brauer. As a general thing, identification of *Hypoderma* larvæ (especially whilst still not fully developed) is scarcely to be depended on from any but an expert; but still, in this instance, from the comparison with the fully detailed descriptions and series of figures by Dr. Brauer,* and other points noted further on, it does not appear possible that this infestation can be any other than that of the Deer Warble, known scientifically as the *Hypoderma diana*.

Almost all of the larvæ (that is, all but the three above mentioned) were white, and transparent, with the prickles, stigmata ("stigmen-platten"), and minute mouth parts, very dark or blackish. The size varied from about three-eighths of an inch in length, and rather over the eighth of an inch in breadth at the sixth segment, up to a length of five-eighths of an inch, with a breadth (at the sixth segment) of about a quarter-inch. The smallest specimens were almost parallel-sided; the broader and older ones somewhat more elongate-oval in shape.

On the upper side of the maggots (in their second stage) the prickles were disposed so as to form a kind of band of clusters across the second and third segment, and at the sides of the two following; but these were sometimes so indistinguishable that it was difficult to make them out clearly, even with the help of a two-inch focus glass. On the under side the maggot is marked down the centre from the second to the sixth segment (inclusive) at the front, and hinder edge, with bands of prickles; those on the fore edge often divided into spots; the seventh segment with only one cross-band at the hinder edge, or front prickles very small. The remaining hinder segments bare.

The three larger specimens were distinguishable at a glance by their different size, shape, and colour. These were about three-quarters of an inch long by three-eighths of an inch in breadth, and a quarter of an inch in thickness, and the colour was slightly ochrey; this more in the case of one of the specimens, of which the prickles were of a brownish and rusty colour, than of the other two. These were very pale, the prickles being so pale that in many of the bands it was difficult to distinguish them clearly; this paleness of the prickles pointing to the very recent change to the third stage.

The shape of the larvæ corresponded excellently both with the descriptions and figure given by Dr. Brauer; namely, of a larva of more slender form than that of *H. bovis* (our common Ox Warble Fly),

* 'Monographie der Œstriden,' von Friedrich Brauer, p. 115, plate viii. figures of larva in first, second, and third stages.

and of a *long* pear-shape. The larva in this stage is much more beset with prickles than before its moult to the third condition. On the upper side from the second to the fourth, *or* eighth, in the middle of the fore edge, is a small group of fine small prickles; in my specimens in which the prickles are most observable, the groups are from the second to the seventh, and the narrow transverse bands of exceedingly small thorns sometimes found at the hinder edge of the fourth, fifth, and sixth segments, are also present. The side-swellings up to eighth or ninth segments prickly. On the under side the prickles are arranged from the second to the eighth segment (inclusive) in groups along the fore edge, and in rows along the hinder edges of the segments. On the ninth segment are two transverse rows; on the tenth one row of prickles; the eleventh bare.

The skin of the larva at this stage is very finely shagreened; and the stigmata brown or rusty in colour, and half-moon or crescent-shaped.

The chief points in the above notes are taken from Dr. Brauer's fully detailed descriptions in his work previously referred to, together with comparison of my own specimens, and are only offered as a guide to distinguish this species in some degree from our two other British kinds of warble infestation. Up to the present time (so far as I am aware) the *Hypoderma diana* is the only kind of Warble Fly known to infest deer in Great Britain, that is to say, the only species of *Hypoderma* of which the maggots infest the hide; therefore, the mere fact of the maggot being so found might be taken as strong presumptive evidence that it was of this species. Nevertheless, as sometimes one kind of warble attack is certainly not limited to one kind of animal, and sometimes there is great doubt as to what other "hosts" a given kind may affect, I have tried to the best of my power to go into the matter here, as in case of such a thing as the Ox Warble Fly attack being extended to deer, should be found to occur, it would be a matter of no small practical importance.

The following notes, with which I was favoured by Messrs. R. and J. Pullman, 17, Greek Street, Soho Square, London, W., are of very useful interest, as being taken from investigation of the great number of deer-hides sent to their hands for purposes of manufacture.

Messrs. Pullman observed with regard to fallow deer:—"The marks of bot or warble have never been noticed on the pelts of fallow deer.*

"The Scottish roe deer pelts are frequently seen very badly 'bot-marked'; but the 'bot-holes' are smaller than in the red deer pelts,

* Here Messrs. Pullman made some remarks on presence of "Ticks" on fallow deer, which I give in the following paper.

and some are so full of small 'bot-holes,' it seems as if a charge of shot had riddled the pelts.

"Red deer.—The Scotch red deer pelts are all more or less infested with marks of 'bot.' The marks extend down the back, each side of the spine. They are much worse in the hind pelts than in the stag pelts, but that is accounted for by the stags being killed earlier in the season, and the maggot not having come to perfection; but the place where the pelt has been punctured is easily seen, and in the process of dressing a hole or deep scar appears in the leather.

"The hinds are more badly damaged than the stags, and very often the 'bot' is seen on the flesh side of the pelt; they are often quite as large and seem to resemble the chrysalis-case, fig. 4, of the Bot Fly." [See my figure of chrysalis of Ox Warble or Bot Fly at p. 134.—Ed.] "The 'bot' mark is also seen in the red deer pelts from some of the English deer-parks, but not so bad as in the Scotch skins, and the chrysalis has not been seen, but the marks are similar to those in the Scotch stag pelts."—(J. P.)

The *Hypoderma diana*, more especially known as the Deer or "Venison" Warble Fly (the Hochwild Hautbremse in Germany), is easily distinguishable from our Ox Warble Fly by its smaller size and greyer colour. It is slightly under half an inch long, whereas the Ox Warble Fly is rather over half an inch in length, and when the two kinds are placed side by side, this variously striped and mottled, but still general grey-brown colour, with the black base to the abdomen, distinguishes it at a glance from the bright black velvety banding of the Ox Warble Fly across the central portion both of the fore body and the abdomen, together with the upper part of the base of the abdomen being yellowish, and the tip orange. In some fresh specimens of this species before me, this colouring shows very beautifully.

The maggot also is smaller than that of *H. bovis*. Likewise in its third stage, more slender in shape, and of a long pear-shape.*

It might be of service, and it would be of a good deal of interest, to know something more of the Warble Fly attack in connection with the red deer to which demonstrably it does much harm; and in regard to the roe deer, it certainly would be very desirable to make out the precise species of the infestation which causes the small perforations, and if I am favoured with specimens in the coming season, I should be glad to do my best to identify them.†

* For full description of *H. diana* and larva, see 'Monographie der Œstriden,' von Friedrich Brauer, Wien, 1863, pp. 113–117, with figures; plates ii. and viii.

† The Red-bearded Bot Fly, *Cephenomyia rufibarbis* (Meigen), a newly-observed British Bot Fly, parasitic on red deer. This infestation (found in Ross-shire, N.B., in the summer of 1894, by Mr. L. W. Hinxman, and identified by Mr. Percy H. Grimshaw, F.E.S., who has paid particular attention to the study of the Diptera)

Ox Warble or Bot Fly, *Hypoderma bovis*, De Geer.—The observations of the past season have confirmed those for which we were previously indebted (in numbers too large to count) to our stock-owners, cattle-breeders, and likewise veterinary surgeons, of the trustworthy serviceableness of the simple means of greatly lessening presence of this infestation where the treatment advised is carried out according to direction.

But still there is great need of more action. The old "grandmother" story of maggots an inch long lying in the putrid lumps they have caused being a proof of the thriving state of the animal still holds its ground to a degree which keeps back useful work; so does also careless and ignorant mis-statement of measures of prevention and remedy.

A *general* rubbing of the back of an infested beast may be confidently trusted to, to do *next to no good* in destroying warble-maggots in their "boils." The thick hair of the beasts, and the smallness of the opening into the warble-boil, will very often prevent the dressing resting on the aperture so as to choke, or entering through it so as to poison, the contained grub. To answer our purpose, the dressing—whether of McDougall's smear, or any other of the many serviceable applications which are well before the public from other good manufacturers—*must* be put on the opening of the warble. Then (*and then only*) they can be trusted to, to destroy the maggot.

Consequently I believe that squeezing out the maggot, where the back of the animal (enjoying the "infestation proof" of its excellently improved health!) is not too sore and inflamed to bear touch, is the surest method. Boys with light hands can do this excellently, and a very small bonus for warbles produced would pay well. We hear

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has not come under my own observation, but—having been favoured by Mr. Grimshaw with a copy of his published observations, and it being an undeniable thing that an infestation causing presence of maggots of upwards of an inch in length at the back of the throats of the infested animals is of some importance—I take leave to give a short note of the attack from Mr. Grimshaw's paper.

During June and July the females (he mentions) lay living maggots at the open nostrils of the red deer. These adhere by their mouth-hooks, and work themselves on until they arrive at the back of the throat, where they lie until nearly ready to turn to chrysalids, and are then ejected by the coughing or sneezing of their host. The maggots are then twelve to thirteen lines long, of a general dirty yellow colour. They go into chrysalis state very shortly after leaving the throat of the deer at the base of walls or under leaves, and from the chrysalids the fly appears at a time of from twenty-one to forty days, or much longer in cold weather. The fly is very hairy; "cheeks with a beautiful tawny beard"; fore body with a transverse band of tawny towards the front, hinder part black; abdomen above densely clothed with hair, of a dirty yellow on the two basal segments, black on the third and fourth, and white from the fourth to the apex. For details of his observations see Mr. Grimshaw's paper in the 'Annals of Scottish Natural History,' July, 1895.

yearly of a bonus at so much a head for queen wasps; but if, instead of a penny or sometimes more apiece, a penny a dozen was given for the warble-maggots, it would soon open the eyes of farm-workers to the existence of what is passed by merely because, in the expressive northern term, "they cannot be *fashed*."

Also it holds back progress very much for recipes which have been proved to answer well for checking or preventing some part of the mischief, to be brought forward as suitable for some other part, or as a cure; it discourages those who are at the trouble of applying them, and from a misappropriation of the use of the following treatment in advice I noticed published (in almost precisely my own words) last year, I think it right to mention that, as will be seen, I only advise it to *prevent* fly-attack :—

"To prevent fly-attack in summer, train-oil rubbed along the spine, and a little on the loins and ribs, has been found useful; so has the following mixture :—4 oz. flowers of sulphur, 1 gill spirits of tar, 1 quart train-oil; to be mixed well together, and applied once a week along each side of the spine of the animal. With both the above applications it has been observed that the cattle so dressed were allowed to graze in peace, without being started off at the tearing gallop so ruinous to flesh, milk, and, in the case of cows in calf, to produce." This recipe will be found on the third page of my leaflet on 'Warble Prevention' (still for gratuitous distribution to all who desire it), and the application is excellently successful for the purpose named. But it is not a *cure;* it does not *destroy the maggots*, it only deters attack.

I am not aware that anything further is needed to extirpate warble attack than to use the measures which we know to answer; but how the use of them is to be brought about beyond the range of the vast number of cattle-owners, farmers, veterinary surgeons, and others, who steadily use them, and prove what good always follows on their use, I cannot tell; but, so far as lies in my power, whether by gratuitous distribution of leaflets, reply to enquiries, or by any other means open to me, I shall be proud and happy to give all the aid I possibly can to the cause of prevention.

A few remarks seem also now to be called for on the *Hypoderma lineata*, Villers, the Ox Bot or Warble Fly of the United States, sometimes also known as the Heel Fly, of which the work in this country (if it is really present with us to the extent to be credited with any work worth mention) has hitherto been classed together with that of our common Ox Warble Fly, the *H. bovis*.

This *H. lineata* is known to be present in this country*; and so

* See 'List of British Diptera,' by G. H. Verrall, F.E.S., p. 20.

far back as the year 1815 it appears to have been known of as present by Bracy Clark, but looked on by him as the male of our *H. bovis*, and also then and since under doubtful synonyms.

As, however, this fly and its maggot are almost indistinguishable from our well-known kind, excepting by skilled and careful investigators, and also its method of *damage* to hides, and its history in the later parts of its life, are similar, it appeared to me superfluous to enter on the subject.

Now, however, circumstances are different. Since the year 1892, in which a most carefully detailed paper of observations of what the whole life-history of this *H. lineata* was considered to be, by skilled official investigation and record of results on the part of the U.S.A. Department of Agriculture, was published in their official 'Bulletin,' a wish has been expressed to me from the late entomologist of the U.S. Department, Prof. Riley, and also from his able successor in office Mr. L. O. Howard, that I would endeavour to find how far our British warble attacks coincided with those of the States. Therefore, besides my own endeavours in the matter, I give first, and mainly from the paper referred to, some of the chief points of the infestation, to facilitate comparison of the habits of the two species.*

This *H. lineata*, Villers, of Europe and America, is slightly smaller than our *H. bovis*, from half a line to a line less in length, besides being less in bulk, and of a lighter make. One marked difference in colouring is that the black upper portion of the fore body, and the band across the middle of the abdomen above, are of a brown-black, not of the beautiful velvety black of our *bovis*. Also the front, sides, and back of the head, sides of the fore body, a band across the base of the scutellum, and the basal segments of the abdomen, are covered with long yellowish-white, almost white, hairs; the terminal segment of the abdomen is reddish-orange. The fore part of the fore body (thorax) is dirty white, and along the top are four prominent raised lines. The figure of *H. bovis*, p. 134, will give, with differences noted, a fair idea of the appearance both of the fly and maggot of *H. lineata*.

Of this (*lineata*) the maggot is stated to be more slender in shape, and more rugose than that of our *bovis*, and, when it has escaped from the warble, of a greyish-brown colour, striped with whitish-grey, and *not* of the browner tint, nor of the thick rounder shape of the larva of our Ox Warble Fly. Also it is shown in diagrams after Brauer (p. 311 of work above referred to) that in *H. lineata* the terminal segment only of its larva is entirely bare of spines; whereas in the larva of *bovis* both this and the preceding segment are without spines.

* See "The Ox Bot in the United States; Habits and Natural History of *Hypoderma lineata*," by C. V. Riley ('Insect Life,' vol. iv. (Nos. 9 and 10) pp. 302–317. Bulletin of the United States Department of Agriculture, Washington, 1892).

These distinctions, however, are difficult of observation, excepting by those used to the work, and *the* important, and really very extraordinary, difference between the two kinds, *so far as the U.S.A. observations show at present*, lies in the method and locality of development of the larva in its earliest stages.

It is considered as established, by the writer and editor of the paper above quoted, mainly on the authority of skilled and minute observations by Dr. Cooper Curtice, D.V.S., that the early part of the infestation is conducted as follows:—

The eggs of the *H. lineata*, which much resemble those of our *bovis* (see figure at heading, p. 134), are laid in rows up to as many as of ten eggs in number on the hairs of the cattle, for the most part on the hairs near the heel (whence the name of "Heel Fly"), or, if laid elsewhere, mostly on the flanks or legs near the heels. By means of the licking of the cattle, the eggs, or rather the hatching larvæ contained in them, *are considered* to be conveyed into the mouth, from whence the little maggots pass into the œsophagus, or gullet, and there it is considered to be proved that they adhere in some way by means of their spines, and pierce through the wall of the œsophagus; the larva at this time being from eleven to fourteen millimètres long—that is, about half an inch. Here it is said to moult off its somewhat prickly skin, and take on the smooth skin of its second stage, in which "for eight or nine months it wanders slowly in the tissues of its host." During the late winter *it is considered* to reach a point beneath the skin in the region of the back, and to penetrate it, tail end foremost, and then again to moult, this time reassuming a spiny coat, and after its long journey to pass the rest of its existence in the way only too well known to us in the case of our *H. bovis*.

So far as has lain in my power I have endeavoured to ascertain whether the *lineata* was present here as a known infestation, and whether the special points, as that of maggots being observable in the œsophagus (or gullet) of cattle, or signs of perforation, were noticeable, and also whether any such maggots had been observed in the tissues. *Hitherto I have quite failed in obtaining information of such being the case.*

Through the chairman of one of our leading butchers' associations especially attending to warble attack, I was allowed to bring the subject before the members, but none of them, in the course of dealing with carcases under their hands, had observed any such presence; nor my own more specially personal enquiry, either with veterinary or practical observers, could I find that these points had been observed. I enquired very particularly by word of mouth as to observation of maggots in the gullet, and I certainly think that, if these occurred at the size mentioned (p. 313 of paper quoted), they would absolutely certainly have been observed.

I certainly think that, if *lineata* was here to any observable extent, we could not fail to have had notice of the eggs. These being placed in rows on the hair near the heels would, or at least I believe they would, attract attention fully as much as those of the Horse Bot Fly. *But I will now take the opportunity* of asking British observers who *may* read these notes to be so obliging, in *case* they find specimens, as to favour me with *a few*.

But the chief point of enquiry was with regard to similarity in characteristics of attack between the two species, and here it seems to me there is marked difference. The *lineata* flies (p. 307 of paper cited) are said to occur at time of egg-laying in "extraordinary numbers." With our *bovis* the difficulty is to see them at all, that is, on reliable authority,—there is plenty of information of fly-attack, which, on being run up, is usually of a Gad Fly, most commonly *Tabanus bovinus*, Linn. With us the main time for laying is the middle of summer, or, taking the edges of the average, from June to September; in the notes quoted, the *lineata* is seen in January, about a hundred observed in February, and on March 1st the fly is out in numbers, and in full tide of oviposition. This is an important difference, for the length of time taken for a *lineata* maggot to progress from gullet to hide (in paper quoted) is "eight or nine months" (p. 316). In my examinations of *bovis* I found the young maggot, just large enough to perceive with the unassisted eye* when removed from the little bloody spot in which they lay beneath the hide, on the 12th of November, which, taking the 1st of August as the middle average date, gives a much shorter time (that is, rather less than half the time) in the case of our maggot to that named as the time taken in the case of the American maggot for progress from egg to existence at the base of the hide.

The little maggots were prickly, and lay full of blood in the slight swelling of the subcutaneous pellicle of the hide caused by their presence, to which attention was drawn by its livid colour and the surrounding inflammation.

I devoted great care to making vertical sections of the hide, and found the channels, or rather passages, as fine as a hair from the sore to the surface, *not* to be smooth at the side, as if caused by pressure (as I noticed at the time), but torn as if by gnawing. I did not find any half-completed passages *from below* upwards; but I did find one half-completed *from above* downwards, at the bottom of which lay a minute body, which was so much crushed by the scalpel that I could not speak with certainty of its nature, but from similarity of the passage with the others I believe it to have been a young maggot piercing its way downwards with its mouth-forks.

* I did not take the measure in millimètres, or part thereof, my work being needed for agricultural service, for which the minute measurement was uncalled.

Yours truly
Georgiana E. Ormerod

REPORT OF OBSERVATIONS

OF

INJURIOUS INSECTS

AND

COMMON FARM PESTS,

DURING THE YEAR 1896,

WITH METHODS OF

PREVENTION AND REMEDY.

TWENTIETH REPORT.

BY

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PREFACE.

The year 1896, like its predecessor, showed presence of many kinds of agricultural insect infestations, including in these crop, orchard, and forest pests, also infestations to live stock, and to deer, though not in any instance to the extent of any one special attack being seriously prevalent over the whole of our island. And this similar state of things appears to be worth record in connection with the markedly different weather conditions of the two years.

In 1895 the extraordinarily low temperatures kept the soil, to a great degree, frost-bound until the end of February, and, with the soil, the insects in it were frost-bound also.

In 1896, on the contrary, the mildness of the season allowed insect traffic both in land and water; but though, for the time being, freedom for depredation was thus in the power of the grubs, there was no sign afterwards that amount of infestation had been affected by the more genial winter temperatures.

With effects of weather conditions *later on*, the case was different. The drought and fine weather of May, and to some degree of the months both preceding and following (see Meteorological Reports quoted pp. 94–96), was admirably adapted for the prevalence of "Leafage Caterpillars," which was one of the especially destructive insect attacks. "Surface Caterpillars" were also unusually early and widespread in the destructiveness of their attacks, presumably from the weather having been unusually favourable for their propagation; and in the remarkably bad attacks of Pine Beetle in Forfarshire, and also near Redditch,

Worcestershire, we have noteworthy coincidence (or sequence) of special settlement of insect infestation where its food was, by power of gales of wind and other meteorological circumstances, thrown down in vast quantities ready for its attack.

The most important observation of the year, from an economical point of view, is probably that of "Onion-sickness," arising from the presence in the bulbs of the Stem Eelworms, which we already know only too well in connection with "Tulip-root," and with "Clover-sickness." Full details will be found under the above heading, and this will very likely give us the clue to the reason of the frequent bursting of Onions, and also of difficulty of growing them (to any serviceable purpose) in special localities, and, the cause once known, prevention of recurrence of attack is cheap and simple.

In the observations of the year I have endeavoured, as far as possible, only to enter on those that have not been previously much brought forward; or, in the case of old-established pests, where advance has been made in methods of prevention, as with "Codlin Moth"; or in unusual amount, as with "Leafage Caterpillars"; or with some new crop subjected to attack, as with "Beet Carrion Beetle" at Potato leafage.

The following list enumerates the greater part of the kinds of British attacks regarding which enquiries were sent, arranged under the headings of the orders to which they belong:—

Beetles (*Coleoptera*).

Alder Leaf Maggots, *Galeruca lineola*	Alder leaves.
Asparagus Beetle, *Crioceris asparagi*	Asparagus shoots.
Beet Carrion Beetle, *Silpha opaca*	Mangold & Potato leaves.
Bacon Beetle, *Dermestes lardarius*	Meat, &c.
Bone and Leather Beetle, *Dermestes vulpinus*	Bones, Wood, &c.
Chafer, Cockchafer, *Melolontha vulgaris*	Leafage and Grass roots.
,, Rose, *Phyllopertha horticola*	Flowers, leaves, and Grass roots.
Pear "Oblong" Beetle, *Phyllobius oblongus*	Pear and Apple leaves.
Pine Beetle, *Hylurgus piniperda*	Pine bark and shoots.
"Soldiers" and "Sailors," *Telephorus* of different species	Carnivorous (beneficial).
Turnip Flea Beetle, different species	Turnip leaves.
,, Flower Beetle, *Meligethes æneus*	Turnip blossoms & buds.
,, Seed Beetle, *Ceutorhynchus assimilis*	Turnip seed.
Weevil, Black Vine, *Otiorhynchus sulcatus*	Strawberry roots, &c.
,, Clay-coloured, *Otiorhynchus picipes*	Raspberry and Hop.
,, Granary, *Calandra* (*Sitophilus*) *granaria*	Stored Corn.
,, ,, ,, *oryzæ*	Stored Corn and Rice.
,, Pea and Bean Leaf, *Sitones* of different species	Pea and Bean leaves.
,, Pine, *Hylobius abietis*	Pine bark and buds.
,, Turnip Root-gall, *Ceutorhynchus sulcicollis*	Turnip root-galls.
Wireworms (larvæ of various Elaters)	Roots of Grass and crops.

Butterflies and Moths (*Lepidoptera*).

Cabbage, Green-veined White, *Pieris napi*	Cabbage leaves.
,, Large White, *Pieris brassicæ*	,,
,, Small White, *Pieris rapæ*	,,
Codlin Moth, *Carpocapsa pomonella*	Young Apples.
Currant Bud and Shoot Moth, *Incurvaria capitella*	Currant shoots.
,, Clearwing, *Sesia tipuliformis*	Currant stems.
Death's Head Moth, *Acherontia atropos*	Potato leaves.
Diamond-back Moth, *Plutella cruciferarum*	Turnip leaves.
Garden Swift Moth, *Hepialus lupulinus*	Roots of many crops.
Goat Moth Caterpillars, *Cossus ligniperda*	Apple roots, &c.
"Looper" Caterpillars of Mottled Umber Moth, *Hybernia defoliaria.*	Leafage.
,, ,, Winter Moth, *Cheimatobia brumata.*	,,
Mediterranean Mill Moth, *Ephestia Kuhniella*	Flour and Meal.
Mill and Corn Moth, *Tinea granella*	Stored Corn.
Pith Moth, *Laverna atra*	Young Apple shoots.
Poplar Hawk Moth, *Smerinthus populi*	Poplar.
Puss Moth, *Dicranura vinula*	Poplar.
"Red Grub" of *Tortrix nigricana*	Plum fruit.
Surface Caterpillars of Dart Moth, *Agrotis segetum*	Turnip, Mangold, &c.
,, ,, Heart and Dart Moth, *Agrotis exclamationis*	,,

Two-winged Flies (*Diptera*).

Cabbage and Turnip Gnat Midge, *Cecidomyia brassicæ*	Seed.
Carrot Fly, *Psila rosæ*	Carrot roots.
Daddy Longlegs, *Tipula oleracea*	Roots of Grass, &c.
Deer Bot Fly, *Cephenomyia rufibarbis*	Nostrils and Throats of Deer.
Deer Forest Fly, *Lipoptera cervi*	In hair of Deer.
Frit Fly, *Oscinis frit*	Oats.
Gad Fly, *Tabanus bromius*	Horses and Cattle.
,, Great, *Tabanus sudeticus*	,,
,, *Therioplectes montanus*	,,
Gout Fly, *Chlorops tæniopus*	Barley.
Horse Forest Fly, *Hippobosca equina*	Horses and Cattle.
House Fly, *Musca domestica*	Manure heaps, &c.
Onion Fly, *Phorbia cepetorum*	Onion bulbs.
Pear Gnat Midge, *Diplosis pyrivora*	Young Pears.
Sheep's Nostril Fly, *Cephalemyia ovis*	Nostrils of Sheep.
Warble Maggots of Deer, *Hypoderma diana*	In hide.
,, ,, Horse, *Hypoderma ?*	,,
,, ,, Ox, *Hypoderma bovis*	,,

Sawflies, Bees, &c. (*Hymenoptera*).

Maggots of Leaf-cutter Bees, *Megachile* sp.	Rose leaves.
Caterpillars of Oak Sawfly, *? Emphytus serotinus*	Oak leaves.
Pear Leaf Lyda, *Pamphilius flaviventris*	Pear leaves.
Slugworm of Pear Sawfly, *Eriocampa limacina*	,,

Aphides, Scale Insects, &c. (*Homoptera*).

Bean Aphis, *Aphis rumicis*	Bean shoots.
Currant Aphis, *Myzus ribis*	Currant and Gooseberry leaves.
Fir Aphis, *Chermes corticalis*	Scotch Fir twigs.
Grass and Corn Aphis, *Siphonophora granaria*	Grass and Corn.
Larch Aphis, *Chermes laricis*	Larch shoots.
Mussel Scale, *Mytilaspis pomorum*	Apple and Pear bark.
Poplar Gall Aphis, *Pemphigus bursarius*	Poplar leaf-stem galls.
Turnip Green Fly, *Rhopalosiphum dianthi*	Turnip leaves.

Various other insect infestations were present, including more especially the Common Earwig, *Forficula auricularia;* the

German Cockroach, *Phyllodromia Germanica;* and the Caddis Worms, or larvæ of the Trichopterous Caddis Flies.

Of other injurious crop infestations, Eelworms were especially noticeable in connection with Tulip-root, Stem-sick Clover, and also (as mentioned above) with Onion-sickness; Wood Lice, Centipedes and Julus Worms, and Slugs, also played their parts; as likewise *Acari* in the form of the Red Spider at Gooseberry; and the Black Currant Gall Mite (*Phytoptus ribis*), which has now become a very widespread and serious trouble to growers.

Some very useful points regarding prevention and remedy (which will be found noted with the respective infestations) have been brought forward. One of these is the destruction of Pear Gnat Midge maggots (see p. 120) in the ground by dressings of kainite, or nitrate of soda, this to such an extent that only a small proportion of the larvæ survived. In itself a cure for Pear *Cecidomyia* maggot is not of very widespread use in this country; but I believe we might work the principle of application very usefully forward by throwing chemical manures of the above nature on the ground where there are grubs or caterpillars (larvæ) just below the surface in a condition in which they cannot get away from the action of what to them is poison. When the larvæ are just turning to chrysalis state they cannot creep down deeper in the soil (out of the way of applications), and I think the plan would be well worth trying to clear infestations of Sawfly maggots from below Gooseberry bushes and Pear trees; and it might be worth while (as an experiment) to try the effect on ground (or on grass, to as heavy an extent as was thought safe) beneath trees where Winter Moth caterpillars were known to have gone down.

The observation, p. 89, of the Winter Moths not crossing a dressing of freshly-slaked lime, though the ground was "literally alive" with them, is also well worth notice.

Besides consulting communications as to successive infestations, there has also been frequent enquiry as to the best means of obtaining serviceable entomological information, and requests for leaflets, especially on Warble Fly, Daddy Longlegs, and Wireworm, of which I keep a good supply in hand; and there has also been a good deal of Colonial communication as to injurious insects or allied pests.

I have to acknowledge with grateful thanks much kind co-operation, not only from British and Colonial colleagues, but also from Continental and American entomological friends, from which I greatly benefit, and return my hearty thanks to all, not only for this, but for the constant and liberal donations of valuable publications on Agriculture and Agricultural Entomology, which I greatly regret not being able to reciprocate as their value demands.

I also desire to express my very sincere thanks to the editors of our agricultural and many of our general newspapers for the great assistance given to my work, and encouragement to myself by their notice; their approbation is a very important matter in my work, and I appreciate it gratefully.

Another point on which my sincere thanks are due is the kind and consoling sympathy which I have received in the severe bereavement I suffered in the past year in the decease of my much-valued sister, Georgiana E. Ormerod, F.E.S. Through the whole course of these Reports, as well as in forming the original plan of reciprocation of agricultural communication, which I have now for twenty years been favoured with, my sister helped me greatly, and from the exceeding interest she took in any point likely to lessen loss from insect injury, I trust my contributors will not think that I am intruding my own great loss too much upon them in paying my tribute of respect to her memory in the following notice of her life in the pages of the publication in which she took such a helpful interest. As her sister, I am not myself fitted for the task, but it is written by an entomologist of high standing, and a valued friend who knew her well. The asterisks merely indicate a passage of kind reference to myself, inappropriate for my own insertion:—

"It is with deep regret that we record the death of Miss Georgiana Elizabeth Ormerod, of Torrington House, St. Albans, England, the elder sister of Miss Eleanor A. Ormerod. * * * * * * * * *. After several months of patiently-borne illness, she passed away on the 19th of August last, full of piety and good works, and justly esteemed and loved by all who knew her. She and her sister were each other's constant companion and fellow-worker, and each sought the other's counsel and aid in

carrying out any plan of work in which she was engaged. Miss G. E. Ormerod's special studies were botany and conchology, and in the latter department she formed a large and valuable collection of shells, which she presented, a few years ago, to the Natural History Museum at Huddersfield. She was highly gifted as a linguist, and acquired an excellent knowledge of French, Italian, Spanish, and German, and was thus enabled to be of the greatest assistance to her sister in correspondence and the translation of foreign works of science. She is most widely known, however, by her remarkable talents as an artist, which were especially employed in the production of a splendid series of diagrams, in which are depicted a large number of the most important injurious insects in all their life-stages." [A portion of which are deposited in the Ormerod Collection of Entomology in the University of Edinburgh.—E. A. O.]

"In addition to her scientific and artistic work, she devoted much of her time and means to benevolent objects, and carried out for many years, at her own expense, a system of distributing books of an entertaining and instructive character amongst the working-classes.

"We cannot but deeply deplore the loss of this eminent Christian lady, who died at an advanced age, full of good works, performed in a most unobtrusive manner; richly endowed with intellectual and artistic talents, which she largely used for the benefit of others; always happy and cheerful in her daily domestic life; kind, hospitable, and sympathetic; ready to help all who deserved her aid and to give wise counsels to those who sought them from her."—(C. J. S. B.) *

To myself no one can replace my sister's help and our companionship of a lifetime; but I have much satisfaction in securing both kind and efficient assistance on many points from my resident lady secretary, Miss Hartwell, who has to some degree assisted me as my amanuensis for many years.

Of the illustrations accompanying the observations I beg to acknowledge, with thanks, those at pp. 23, 25, 35, 125, and 143,

* See obituary notice by the Rev. Chas. J. S. Bethune, Principal of the Trinity College School, Port Hope, Ontario, Canada, in 'The Canadian Entomologist' for Nov., 1896. The Portrait of Miss Ormerod given in the Frontispiece is from a photo taken by Messrs. Elliott & Fry, of Baker Street, London, W.

as being by permission of Messrs. Blackie, of Glasgow; that at p. 29, and the moth at p. 93, are from Newman's 'British Moths'; and the others, where not acknowledged accompanying, are almost entirely drawn for me by Messrs. Horace or E. K. Knight, of the staff of Messrs. West, Newman & Co.

For myself, I should like to be permitted to add that, so long as my health allows, I much desire to continue in communication with my valued and kind co-operators on prevention of loss from insect attack, and I shall be happy to give the most careful attention in my power to any enquiries with which I may be favoured.

ELEANOR A. ORMEROD, F.E.S.

Torrington House, St. Albans,
February, 1897.

List of Attacks of Injurious Insects, &c., noticed in this Report.

NOTES OF OBSERVATIONS

OF

INJURIOUS INSECTS

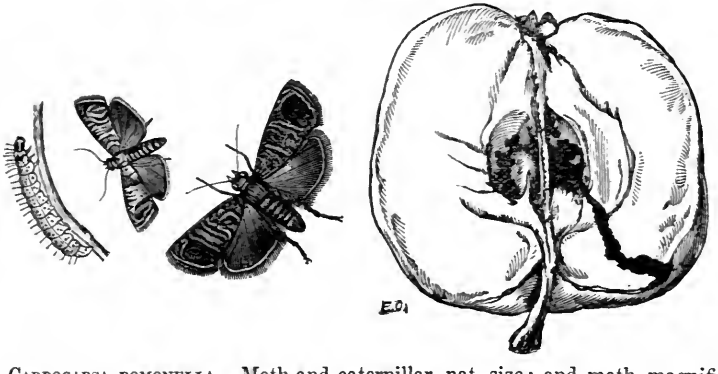
AND

COMMON CROP PESTS

DURING 1896.

APPLE.

Codlin Moth. *Carpocapsa pomonella*, Linn.



CARPOCAPSA POMONELLA.—Moth and caterpillar, nat. size; and moth, magnified (after figures in 'Insects Injurious to Fruits,' by Dr. W. Saunders); infested Apple from life by Editor.

CODLIN MOTH attack is one of the yearly troubles of the fruit-grower, and though other kinds of infestation (as, for instance, that of the Apple Sawfly) doubtless play their part, in causing maggotty Apples, yet in this country we may safely lay most of the damage, to workings within the Apples of the little larvæ of the *Carpocapsa pomonella*. In the course of last season, nothing was reported to me worth record in the way of any advance in information in remedial measures here, and perhaps also the attack was not worse than usual, though (to give a single instance) in one case of 2000 injured Apples

examined about 1500 were found to be "maggotty," and of 500 Pears about half were damaged; but still some enquiries were sent me which it may be useful to answer again here; and in the past few years such advance has been made in other countries, in measures both of prevention and remedy, that some of these points also may be usefully referred to.

In regard to the kinds of fruit liable to infestation. Apples are the kind chiefly attacked, but Pears also are sometimes much injured. Besides these, Quince, Plum, Peach, and Apricot may be just named as liable to infestation, as also the fruit of the Hawthorn and the fruit of the White-beam tree.* Walnuts have been mentioned from time to time as found to be infested, and, for certainty of this taking place, at least occasionally, a short record of his personal observations, by Mr. Robert Adkin, F.E.S. (in 'The Entomologist,' Jan., 1896, p. 2), is well worth notice. To this Mr. Adkin adds mention of this species (*Carpocapsa pomonella*) having been bred frequently from Sweet Chestnuts as well as from Walnuts by Mr. W. West.

Pear infestation from the Codlin Moth is of frequent occurrence in many parts of the world; I have never, however, had the opportunity of examining it myself until last summer, when I observed some of the fruit on a "Williams" Pear, trained on a wall with a western exposure, in my own garden, were turning yellow, and *some* of these fell off, and within them I found the Codlin Moth maggot. The fruit on another "Williams" Pear growing near by (in this case a standard tree) was similarly what is called "maggotty." It is noted by Prof. Riley † that Pears infested by *C. pomonella* are liable to hang on the tree after the exit of the maggot, and likewise that they do not readily fall from the tree on being jarred.

It would be of serviceable interest if in the course of the coming season we could have some observations of this attack as infesting Pears, and perhaps also whether it was more prevalent where, from grafting on inappropriate stocks or other causes, large, ill-shaped and deeply cracked growths of bark have formed at the base of the stem. This has been the case to a quite unusual extent on some of the trees in my own garden, and may possibly account for Codlin Moth presence having increased to such an extent as to require careful attention.

The caterpillar or larva, when full grown, is from rather under two-thirds up to three-quarters of an inch in length; at first it is

* Respectively *Cratægus oxycantha* and *Pyrus aria*. In the course of last year it was brought under my notice by Prof. Jos. Mik, of Vienna, that for Continental reference it would be very desirable that in the case of wild plants the scientific name should be added to the name popularly used in this country, and I adopt his suggestion with thanks.

† 'Sixth Annual Missouri Report,' 1874, p. 10.

whitish, later on more or less of a pink or flesh-colour. The head when young is blackish, later on lighter in colour; the shield on the segment next the head varies similarly in colour with age of the grub, and so does the tail segment. It has "eight little black dots or warts on each segment, so arranged as to make two rows down the back, and one row on each side" (Frazer S. Crawford). The caterpillar has three pairs of claw-feet; four pairs of sucker-feet beneath the body, and another pair at the end of the tail.

The cocoon is given by Mr. L. O. Howard as "white inside and greyish outside, and usually covered somewhat with bits of bark or minute fragments of whatever substance the worm happens to spin on."

The moth is about four-fifths of an inch in spread of the fore wings, of a somewhat brown tint looked at generally, but the fore wings have a brown patch at the tip, in which are markings of gold colour, or of golden scales, or streaks of gold; and the wing is varied (see figure, p. 1) with irregular transverse streaks of brown and grey. The brown of the hind wings is deepest towards the outer edge, but the general appearance of the moth differs much in marking, from brightness to dull grey or brown, according to whether it is held in the bright sunshine or otherwise.

The early part of the life-history of the Codlin Moth appears to be very similar in all the countries where the infestation is known. The moths come out about the time of the opening of the Apple blossom, and, when the petals have fallen and the embryo fruit is beginning to set, the female lays her egg at the eye of the Apple; that is, at the end opposite the stalk, where it is sheltered in the crumpled-up remains of the calyx. Usually only one egg is laid, but sometimes two or three may be deposited; occasionally egg-laying has been found to occur at the stem end of the Apple or on the cheek.

The maggot hatches in about a week or ten days, and burrows into the Apple, and its presence is shown by the brown powdery excrementitious matter which it throws out at the eye of the Apple, or at the end of the passage which it gnaws through the solid Apple to the side for the purpose of getting rid of the dirt. In about four weeks from the date of hatching the maggot is full grown, and by this time it has done so much mischief within the young fruit, that the Apple falls to the ground, often (though by no means always) with the maggot still inside it. Sometimes the larva or maggot lets itself down from the fruit (whilst this still remains on the tree) by the help of a silken thread spun from its mouth; or, again, it may simply creep out of the Apple, and make its way along the branches to the trunk.

But whether by creeping from the fallen Apple along the ground, or by leaving it in any other manner, the maggot next makes its way to a neighbouring Apple-tree stem, and there it shelters itself in a

cranny of the bark or under a loose piece, where it spins a cocoon, and where it turns to the chrysalis state, from which the moth comes out either in about a fortnight, or at the time of the Apple-blossom in the following year, according to whether there is one brood or two in the course of the season. In England it is considered that this moth is only single-brooded.

This matter is important practically, and those who wish to follow it up will find considerations on it nearly up to date in the paper by Mr. Marlatt referred to below.* In this Mr. Marlatt gives evidence, from known entomologists, showing the countries in which the moth has been observed to be respectively single- or double-brooded. Amongst these it is considered that in northern Europe, including northern and central Germany, as well as England, the Codlin Moth is *single*-brooded, but in France (from actual breeding records) *double*-brooded. From examination of the later U.S.A. published records, Mr. Marlatt considers that "the occurrence normally of a second or summer brood of moths throughout the United States, with the possible exception of the north-east Atlantic region, cannot be doubted" (p. 248); and he draws the conclusion from his personal observation and digest of information, "that the number of broods of this insect is merely a question of climate and temperature."

This matter is important to ourselves, because (as pointed out by Mr. L. O. Howard†) though many of the maggots may leave the Apples, and resort to the bark of the Apple-trees similarly to those of the first brood, yet many may still be in the Apples when gathered, and stored or packed. These maggots come out presently, and spin their cocoons in any convenient cranny of the barrel or other packing-vehicle, or locality. Thus a large supply of infestation is quite likely to be imported together with the Apples to their purchasers, and set infestation on foot where transmitted to fruit grounds.

Irregularity of development, so that "about the same time full-grown larvæ, young larvæ, eggs, and pupæ will be found," is another point to which Mr. Howard draws attention, and to which, from my own observations of the past year, I think attention might usefully be given here.

Prevention and Remedy.—Where fruit is found to be observably falling in large numbers, some of it should be split open, and if infestation of the Codlin Moth caterpillar (*vide* description above, and figure, p. 1) is found inside, the fruit should be gathered up and

* "The Codlin Moth Double-brooded" ('Insect Life'), by C. L. Marlatt, U.S.A. Department of Agriculture, vol. vii., No. 3, Dec. 1894, pp. 248–251.

† See "The Codlin Moth, *Carpocapsa pomonella*," by L. O. Howard, in 'Report of the Entomologist of U.S.A. Department of Agriculture for 1887,' Washington, 1888, pp. 88–115—a most excellent and exhaustive treatise.

destroyed. This should be done as soon as possible, if it is to do much good; and jarring or shaking the boughs of trees which are apparently much infested on to cloths, answers well, for thus a good proportion of the infested Apples can be gathered up before the grubs have time to get away, and the fruit can be thrown at once to wet manure or destroyed in any convenient way. In orchard-growing on the very large scale of U.S.A. cultivation, it has been found to answer well to feed sheep and pigs on the ground. These are supplied with requisite amount of dry food, and from the destruction of the maggots and trampling and manuring of the ground the infestation was found to be much lessened, and also the trees to thrive well. To prevent gnawing of the smaller trees, a wash of "a solution of soapsuds, whale-oil soap, and sheep manure was applied once a month, and water also given."* In this country the water might or might not be needed.

But though destroying the fallen Apples gets rid of a great deal of infestation, it does not help us with regard to the caterpillars that go down to the ground by threads, and creep up the Apple trunks, or creep down to the trunk from unfallen Apples on the twigs. For this we need various methods of treatment of the bark, and the first in order are those for trapping or stopping the maggots on their ascent (or on their journey down the tree). A very simple plan recommended by the late Prof. Riley, Entomologist of the U.S.A. Department of Agriculture, was to wind a hay-rope in three coils round the trunk of the tree at a little distance from the ground, and to apply other hay-bands also to the larger branches. The hay-band was fastened as tightly as it could be pulled; and Prof. Riley's rules as to its application were as follows:—"First, the hay-band should be placed around the trees by the 1st of June, and kept on till every Apple is off the tree; second, it should be pushed up or down, and the worms or chrysalids crushed that were under it, every week or at the very least every two weeks" [this appears to me very important, E. A. O.]; "third, the trunk of the tree should be kept free from rough old bark, so as to give the worms no other place to shelter; and, fourth, the ground itself should be kept free from rubbish." †

The point of the above treatment is—have the bands for trapping the maggots placed early enough, and clear out all that are captured soon enough; and remove all other shelters, so that the maggots have (so to say) no choice but to resort to those which can be kept under observation.

With a similar object, *banding the trees*, as especially recommended by Mr. Frazer Crawford, may be carried out in various ways, as

* See detailed account, by Mr. J. S. Woodward, in 'New York Weekly Tribune' for June 9th, 1880, quoted at length by Mr. L. O. Howard, p. 96 of his paper previously referred to.

† See Mr. L. O. Howard's Report, previously referred to, p. 100.

follows:—"For this purpose, old sacks, old clothes (if woollen all the better), or brown paper may be used, but the latter is not so good. These should be cut into strips about eight inches in width, and of a sufficient length to go round the trees. Each strip should then be folded in half, and the folded edge again turned down, so as to make the double fold about an inch and a half wide. The band will then be about two and a half inches wide. Insert a piece of cord, or, what is better, wire, in the double fold, and tie round the trunk of the tree, about six inches from the ground, taking care that the folds are at the top, and the second fold placed next the tree. . . . The wire can easily be untwisted to examine the bands, and twisted again to fasten them on. The bands should be examined weekly as long as there is any fruit left on the trees, as also on any tree which, having no fruit, is yet growing near infested trees with fruit on. Rags or paper should be fastened in the forks of the trees, in order to trap any caterpillars that may leave the fruit without reaching the ground, which, of course, should be examined regularly with the others." *

For a simple and practicable method of scraping the trees so as to clear away all shelters for maggot infestation, I do not know of any better plan than that recommended by Mr. Frazer Crawford in his pamphlet referred to below, therefore I again quote verbatim, duly acknowledging the source:—"Spread any old sacks, or other suitable material round the tree as far as any scrapings are likely to fall. Commence on the tree as far as there is any loose bark and scrape it carefully off. Examine and scrape all crevices in the bark, or those formed in the forks of the tree. Continue scraping until the ground is reached. Next gather the scrapings carefully off the sacks, and burn or otherwise destroy them immediately. This scraping should be done annually early in the winter.

"*Washing the trees.*—After scraping the trees a wash should be applied for the purpose of destroying any larvæ or chrysalises remaining in the crannies of the tree."—(F. S. C.)

With regard to washes, it is really impossible to enumerate the variety that are before the public that would answer the required purpose. Such preparations as kerosene emulsion; or the anti-pest of Messrs. Morris, Little, & Son, of Doncaster; or the soft-soap and sulphur compound of the Chiswick Soap Co., or many others with a basis of coarse strong-smelling soap which would fill up crevices and stifle larvæ within them, and an addition of some special insect deterrent as mineral oil or sulphur would be sure to do good.

* 'Report on the Fusicladiums and Codlin Moth,' &c., by Frazer S. Crawford, Inspector under the Vine, &c., Protection Act. Published by direction of the Hon. Commissioner of Crown Lands. Government Printer, Adelaide, S. Australia, 1886. Price 1*s*.

To the above precautions should be added (where the large scale of trade cultivation is concerned) great care as to bringing infestation into the grounds in cases which may have held home-grown or imported Apples. As noted at p. 4, larvæ or maggots of the *second brood*, in some European and many of the U.S.A. districts, may have been in the Apples when packed, and may very likely indeed have established themselves for change to chrysalis and moth state in crannies of the barrels, boxes, crates, or other cases used for transmission. All such packages, or even such as have been in contact with such cases, should be disinfected. Thorough scalding with boiling water would probably do all that is needed, and this simple plan would often be carried out where growers would not care for more trouble. But for those who wish for a special application, "dipping the cases for two minutes in a lye of caustic soda of a strength of one ounce to three gallons of water, or pouring the solution into them," will be found useful.

But as time has gone on it has been more and more observable that something beyond measures of prevention are needed, which, in localities where the infestation has escaped all measures for its destruction in its early stages (or more commonly where nothing has been done to destroy it), may be brought to bear cheaply, and with good hope of success, at the time when attack customarily takes place on the young setting Apples, that is, when the blossom-leaves are falling, or rather have just fallen. *For this purpose spraying with Paris-green* has been found to answer well.*

In the Report of Prof. Lawrence Bruner, Entomologist of the University of Nebraska, U.S.A., bearing date 1894, which brings the observations fairly up to the present time, he observes:—

"The best remedy now known, and the only one by which the first brood is killed and a large per cent. of the fruit saved from their ravages, is the use of one or other of the arsenical sprays, composed of London-purple or Paris-green with water. These are to be applied just after the fruit has 'set,' and before it has become heavy enough to droop, or the calyx end to turn downward. One or two thorough sprayings at this time will, it has been proved, save at least seventy per cent. of the loss otherwise experienced. The ratio of these poisons best adapted for the purpose has not been definitely ascertained, since this varies with conditions of climate, latitude, &c." [A caution that should be carefully noticed.—E. A. O.] "About four ounces of the Paris-green and three of the London-purple to the barrel of water will probably be sufficiently strong to kill the worms, and at the same time not injure or kill the foliage during ordinary weather at this time of year."—L. B. (From 'Nebraska State Horticul. Rep. for 1894.')

* London-purple would answer the same purpose, but has not as yet been so much brought forward in this country.

The above extract gives date of application, but (to ourselves) not precise proportion save to those acquainted with capacity of the U.S.A. "barrel." But reports from trustworthy experimenters name one pound of poison to a hundred gallons of water as safe and serviceable.

Prof. Cook remarks:—"We must use a weak mixture; one pound of the poison to a hundred gallons of water is best; then we can make thorough work without injury to our trees." *

Prof. F. M. Webster, of Purdue University, U.S.A., also a thoroughly trustworthy authority, recommended Paris-green, sprayed as a liquid mixture, as a good remedy. "Used in this form one pound of the poison to one hundred and forty or fifty gallons of water, if applied in the form of a spray, by the aid of any of the machines mentioned, . . . will be found effective against the Codlin Moth."—(F. M. W.)

In our English experiments it appears hazardous to use the Paris-green mixture as strong as mentioned above.† For spraying Apple-trees as a remedy for caterpillar, one ounce of Paris-green to twenty gallons of water was found sufficient. Mr. Masters, of Evesham, considered the green may safely be applied up to twice the above-named strength, namely, one ounce to ten gallons of water; but in all cases where the operators are not accustomed to the use of arsenical poisons, careful experiment should be made as to what strength can be borne, before spraying on a large scale.

The Paris-green is procurable from Messrs. Blundell & Spence, Hull, in a slightly damped condition, and also more finely ground than the ordinary powder, and in this condition is safer for use, as the powder does not fly about, and is therefore not so liable to be prejudicially inhaled by the mixer, also a smaller quantity is required. If the same proportion of this prepared Paris-green is used as of the ordinary powder, great damage is likely to ensue.

It must be remembered, as was brought forward when the use of Paris-green was introduced into England by our Evesham Committee of Experiment in 1890, that this aceto-arsenite of copper is poisonous, and therefore should be kept safely out of the way of children or careless people.

Details of method of application are now so fully before the public that it seems needless to repeat them here; but for those who may care to have all requisite observations on methods of applying the arsenite, and also precautions in its use, I may mention that I should be happy to forward gratuitously to applicants copies of my own eight-page pamphlet on this subject.

The kinds of sprayers, whether as knapsack or hand or horse

* A. J. Cook, Proc. 7th Ann. Meeting Soc. Prom. Agr. Sci., Buffalo, N. Y., 1886.

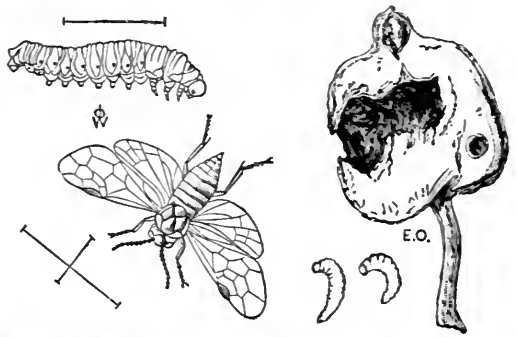
† For details see my 'Manual,' second edition, pp. 357–360.

machines, are being so constantly improved, and they are in such numbers before the public, that it is unnecessary to enter on them here.

One other point remains on which I had especial enquiry last summer, namely, *What are the parasites of the Codlin Moth, and can they be utilized?* The reply to this is that there are several kinds of ichneumon flies well known (and figured in various of the standard papers on this attack), and which occur in Europe and also in America,* and which do (or may do) some good to us in lessening amount of Codlin Moth, but there does not seem to be any probability that they can be artifically utilized, any more than the various carnivorous beetles which prey on the Codlin Moth caterpillars if they get opportunity of finding them unsheltered.

Our only really available remedies against this infestation appear to lie, 1st, in destroying infested Apples; 2nd, in trapping the caterpillars and destroying their shelters; and 3rd, on being well on the alert at the time of the blossoming of the Apple, and by careful spraying preventing the very beginning of the attack.

The only other Apple infestation which we have in this country which I believe can be at all confused with that of the Codlin Moth is that of the Apple Sawfly, of which I append a figure to show that the method of attack to the young Apple is different, and also that the sawfly caterpillars may, with the help of a common hand magnifying-glass, be easily distinguished by its greater number of sucker-feet from that of the Codlin Moth.

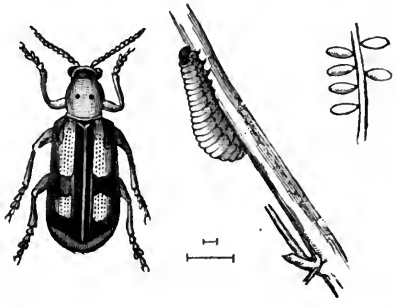


HOPLOCAMPA TESTUDINEA.—Female sawfly and caterpillar, magnified, with lines showing nat. size, after Prof. J. O. Westwood; also caterpillars, nat. size, and infested Apples. (For description and life-history see Fifteenth and Sixteenth Reports on Injurious Insects, by Editor.)

* In Europe, *Phygadeuon brevis*, Grav., *Pachymerus vulnerator*, and *Campoplex pomorum*, Ratz; in America, *Pimpla annulipes*, Br., and *Macrocentrus delicatus*, Cresson. See 'Praktische Insekten Kunde,' Dr. E. L. Taschenberg, pt. iii. p. 230; paper by L. O. Howard, previously quoted, p. 94, and other writers.

ASPARAGUS.

Asparagus Beetle. *Crioceris asparagi*, Linn.



CRIOCERIS ASPARAGI.—Beetle, larva, and eggs, all magnified; natural length of egg and beetle shown by lines.

Attack of Asparagus Beetle is not often reported as a wide-spread infestation, but sometimes it does a deal of harm locally, chiefly by the grubs feeding on the leaves, and on the tender rind of the shoots. Thus, besides general damage, the portion of the shoots above where they have been barked perishes, and the beginning of the attack is shown by patches of pale brown shoots, or withered sprays, being observable amongst the light green feathery growths of the Asparagus early in the summer. Where this is seen, attention should at once be given to getting the attack under, which otherwise may very likely continue in successive generations until autumn.

The attack is always more or less present, but in the past season some rather more special observation than usual was forwarded.

On July 3rd specimens of the Asparagus Beetle were sent me from the Toddington Orchard Grounds, Winchcombe, Glos., by the superintendent, Mr. C. D. Wise, showing the severe damage which was being caused to the Asparagus by this infestation, and begging for any information which might help to get rid of the pest.

The life-history of the attack is that the beetles appear early in the summer;—so far as I have found record, from what have passed the winter in the chrysalis or pupal state (but I have no personal knowledge on this point). These beetles are very easily recognizable by the somewhat cross-shaped markings on their wing-cases, from which they take their occasional name of "Cross-bearer." They are of a narrow, straight shape, only a quarter of an inch long, by a little more than a third of that measure across the wing-cases. The head

and long thread-like horns are blackish; body behind the head red, with two black spots; and the wing-cases ochrey yellow, with a black stripe down the centre, and a branch from each side of it of a bluish shiny black, which together form a kind of cross. Besides these there are other black markings on the yellow ground, especially of spots or patches at the tip and base of the wing, sometimes so various that in the five specimens before me each one is differently marked from the others.

The little spindle-shaped dark eggs (figured at p. 10) are only about one-sixteenth of an inch in length, and may be found in great numbers sometimes, arranged in rows, and fastened by one end to the shoots or leaves, or unopened flower-buds.

The grubs are of a kind of slate or dirty greenish colour with black head and legs, a little more than a quarter of an inch long, somewhat rounded at the sides, and enlarged behind the middle. From their power of curling the tail extremity (which is furnished at the end with a fleshy foot) round the slender spray or whatever they may be feeding on, the grubs are hard to remove, and on disturbance they emit a large drop of fluid from the mouth. They are full-fed in a fortnight, when they go down into the ground, and form parchment-like cocoons, in which they turn to the chrysalis (*i.e.* pupal) state, and from which, in summer, the beetles come out in about a fortnight or three weeks, and as the females lay eggs very shortly after development, the infestation may be found in all stages till autumn.

Then, though I am not aware whether this part of the life-history has been observed in this country, on the Continent it is recorded that, instead of going rapidly through all its changes as before, the infestation remains in chrysalis state through the winter, from which the beetles come out in early summer.

On August 21st very plentiful samples of badly gnawed Asparagus-shoots, together with specimens of the beetles and grubs, were sent me by Mr. Wm. F. Wratislaw from Rugby, with detailed notes of observation, of which I extract some as of practical interest. Mr. Wratislaw observed:—

"I beg to forward specimens of a grub and beetle which for some weeks back have been working the Asparagus beds. My attention was first called to the beds by a friend asking if I could find out what was the cause of his Asparagus bed dying off and turning yellow and strawy (so early), as is common when the beds dry off at the end of summer. I looked round and found these bluish grey grubs varying in size from about one-eighth to over a quarter of an inch in length (the latter about the biggest). They are very tenacious, not at all given to fall off, or throw themselves off, as do the Gooseberry and Currant grubs, but hold on firm."

Mr. Wratislaw, after various observations, further noted :—

"I used daily to go carefully round the beds with finger and thumb, and roll or squeeze the grubs"; and this treatment appears to have checked attack, for he further remarked:—"The Asparagus beds, which at one time looked dying or dead, are now, since rain came, beginning to throw fresh fronds, and so recover below, and higher green fronds pushing up, so that the plants and roots will not perish as was at first thought likely, though no doubt they must have received a severe check. The same was happening to some beds of my brother's, . . . but 'finger and thumb' saved their looking anything like so bad, and now they look as good as ever."

The above remarks show how much may be done by careful hand-picking of the grubs; and the following note, sent me on August 30th, gives some details as to clearing the beetles also by hand-picking. A clearance on three days (presumably at leisure time) got rid of 436 beetles, which in moderate garden cultivation would make some amount of difference in impending egg-laying, and suggests that even on a large scale of cultivation hand-picking the beetles might be worth attending to. Mr. Wratislaw noted that the beetles on alarm usually fell straight down, or made a kind of spring to some adjoining small branch, and if they fell to the ground they lay quiet for a minute or two, but from the pale markings on their wing-cases they were easily distinguishable for recapture.

Prevention and Remedy.—Very much may be done by moderate care to check attack at its commencement. Cutting off the shoots which are noticeably badly infested with eggs is a sure way of lessening infestation.

Hand-picking of the grubs is difficult on account of their strong powers of holding fast by their tails, but a little soot or salt, or other substance obnoxious to the grub, held in the fingers at the same time, has been found to help to make them loosen hold. But where there is no objection either on account of the unpleasantness of the operation, or of the smearing of the shoots with dirt, Mr. Wratislaw's plan of crushing the grubs with finger and thumb would be perfectly effectual. Syringing with water warm enough to make the grubs fall off, yet not hot enough to hurt the leafage, is an excellent plan (which I noticed some years ago in my 'Manual'). Most of the grubs fall down when they feel the warm water, and the rest of them on the shoot being sharply jarred; and if soot or some other deterrent dressing is thrown over the grubs when on the ground and still wet, I have found this treatment prevent any return of the grubs to the plants. A large number of beds may soon be dressed by a man and boy going round together, one to syringe, and the other to jar the stems and throw soot or whatever may be preferred on the fallen grubs.

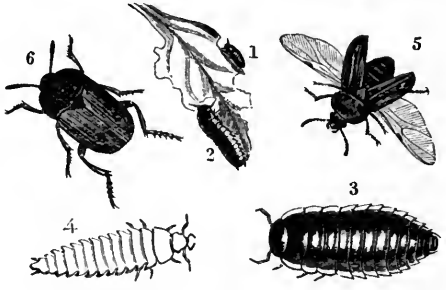
Shaking the beetles down into a basin with any fluid in it which will prevent them escaping is also a good plan. Strewing the plants well with lime early in the morning whilst the dew is on has been found useful; and probably if, instead of lime alone, a mixture of lime and gas-lime in equal quantities, with a small addition of soot and of sulphur, all pounded up finely together, was similarly used, it would be still more serviceable.

I am not aware of any observations having been made as to prevention of attack by winter dressings or spring treatment of the beds. Digging of course is out of the question, but pricking with a fork two or three inches deep is admissible if care is taken not to wound the roots, and something perhaps might be done in this way, in spring, towards throwing the surface open for birds to get at the grubs.

Salt does not appear to be of service in this matter, for in Mr. Wratislaw's notes regarding his bad attack he observed that the beds had received a good dressing of salt "as usual" in the spring; but where, as in localities near the coast, seaweed is sometimes used for spring dressing instead of salt, it would be of practical interest to have information whether this answered as a deterrent; but for a straightforward, reasonably practicable means of prevention I believe that being on the alert early in the season, and snipping off and destroying egg-infested leaves and sprays, and likewise those on which the grubs are observable, would answer well in keeping the infestation in check.

BEET CARRION BEETLE.

Beet Carrion Beetle. *Silpha opaca*, Linn.



SILPHA OPACA.—1–4, larva, nat. size and magnified; 5, 6, beetles, magnified; natural length about five lines.

The *Silpha opaca*, popularly known, on account of the double nature of the material on which it feeds, by the double name of Beet Carrion Beetle, has been recorded in the past season as not only in the locality under observation causing serious damage to Mangolds, which for some time back it has been known to infest, but, on the failure of other food under its devastation, carrying on its attack to Potatoes.

Why this pest should continue persistently in this one locality for years, when in others it has appeared and then disappeared (or at least not been reported), is unexplained; but it is a curious circumstance that whilst in 1888 it severely injured Mangolds at various widely separated localities in England,—as near Shrewsbury; near Newport, Mon.; and near Honiton, Devon,—no more was reported as to its presence from any of these places; whereas in 1891 it appeared and did much damage to Mangolds at Batworthy, a small farm on Dartmoor, a few miles from Chagford in Devonshire, and there it reappeared slightly in 1892, 1893, and 1894; and in 1895 it nearly destroyed the crop. In the past season attack has again appeared with various amounts of severity (as will be seen from the following communication) on various farms in the immediate neighbourhood of Batworthy, where it was first noticed.

On June 11th last Mr. F. N. Budd, who had carefully recorded this yearly appearance of the pest, writing from North Tawton, Devon, favoured me with the following observations:—

"I have again to report an attack of the Carrion Beetle grub on Mangolds growing in a field about half a mile from Batworthy, where the previous attacks, one of which is recorded in your Report of 1892,

occurred. This year the grubs have cleared the whole crop. They not only devoured the Mangolds as soon as they appeared above ground, but they also fell upon the Spurrey (*Spergula arvensis*), with which the field is infested, and now that very little of this is left they have attacked the Potatoes, the first row of which adjoining the Mangolds in the same field is a good deal eaten. They appear to prefer the Mangolds and the Spurrey, but there is no doubt of the fact of their eating the Potato in case of need; I myself saw three or four in the act. I learn from enquiry that two farms in the immediate neighbourhood have similarly suffered, but only in a comparatively slight degree. In my case I think the eggs were probably carried to the field in the farmyard manure which was brought from Batworthy."—(F. N. B.)

This matter is of considerable interest, as hitherto Potatoes have been reported as among crops not liable to be attacked by this infestation, and consequently available for ground known (or supposed) to be infested. In Curtis's 'Farm Insects,' p. 389, Potatoes are mentioned, together with Turnips, Peas, and Beans, and likewise Carrots, Parsnips, and Swedish Turnips, as crops that were uninjured where Mangold-wurzel in the same fields was attacked; and in my own Annual Reports * I find no mention of attack either to Potatoes or the crops mentioned above or Cabbage, which are all noted as succeeding "admirably well" on land where Mangolds were destroyed, or to the field weed known as Spurrey (*Spergula arvensis*).

It is certainly an unfortunate thing that a pest which has the power of sweeping off Mangold and Beet crops, by its grubs completely devouring the young leafage, should have thus established itself in the small area known to be infested; but we do not seem to have made any advance in means of getting rid of it. Details of its life-history will be found in Reports referred to in note; and Mr. Sym Scott's observations, and considerations of preventive measures based on habits, given at pp. 94–96 of my Twelfth Report, are well worth study.

The grub (as will be noticed in the figure, p. 14) is very peculiar in shape from its general likeness to a rather large, blackish woodlouse. Some, as figured in outline, are of a narrower shape. The beetle is flattish, brown-black, and with three raised lines along the wing-cases. The method of life is for the grubs to feed on the young Mangold leafage, especially (according to Mr. Sym Scott's careful observations) at night, or when the leafage is damp, going down into the ground in the heat of the day, and when the leaves were eaten off (as occurs in bad attack) the maggot was found to gnaw off "the tender root about a quarter of an inch below the surface of the drill."

* See Eighth, Twelfth, Fifteenth, and Nineteenth Reports on Injurious Insects by Editor.

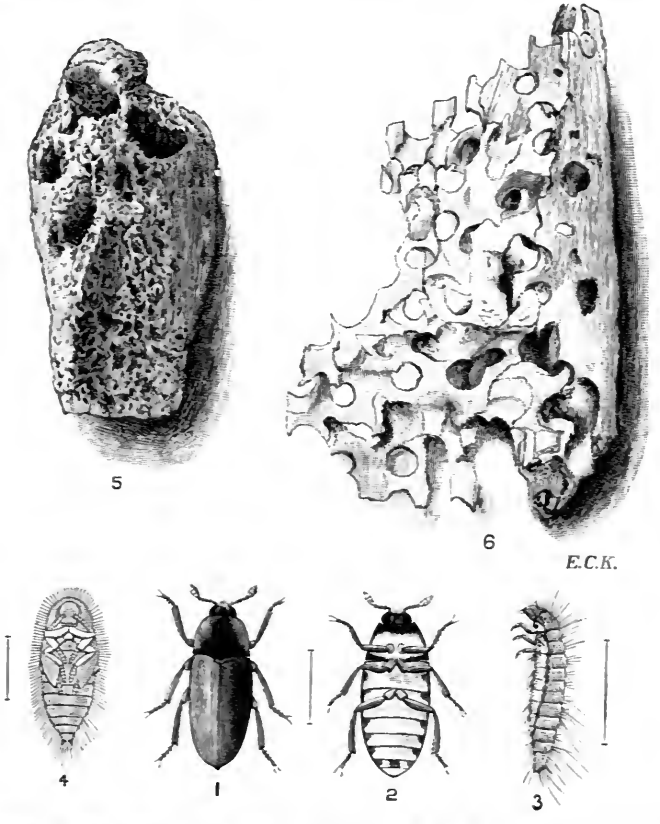
Dates of attack in the notes before me range during the earlier part of June up to about June 19th, when many of the grubs were nearly full grown. When full-fed, they go down into the ground to a depth of about three to four inches to change to chrysalis state, from which the beetles appear in about three weeks. The beetles are to be found in winter or spring under stones, clods, or in moss or rotten wood, and "*are common in April in dead animals.*"

This last item seems to me to be very possibly an important point to notice relatively to the carrion-infesting part of their habits. The attack has been found both where bone manure has been used and where it has not been used, so this gives us no clue; but the fact mentioned by Mr. F. N. Budd (p. 15), of the infestation having appeared where farm manure was carried from Batworthy, points to a method of transmission which the attraction of garbage, putrid animal matter, and the like, would make very likely.

The suggestion of Mr. Sym Scott, in the observations previously referred to, that he purposed knocking "about the Mangolds a few wild pigeons, rooks, hawks, or similar vermin, which we generally shoot in spring, and trying what effect" this would have, is worth consideration. In many insect attacks "trapping," that is, attracting the insects to some food, which can with no more than reasonable trouble be presently destroyed with the contained pests, answers well, at small cost; but we much need further information as to how to "stamp out" the infestation, and as the kinds of crops or weeds liable to suffer under attack are gradually found to be more numerous than we were aware of, I have this year placed the above short observation under the double name of the insect rather than under any one of the crops which it injures or ravages to complete destruction.

BONES, &c.

Leather Beetle or **Toothed Dermestes.** *Dermestes vulpinus*, Fab.



DERMESTES VULPINUS.—1, beetle, upper side; 2, beetle, under side; 3, larva; 4, pupa: all magnified, with lines showing natural length; 5, bones, and 6, wood, gnawed by infestation. The pupa after Prof. Riley; otherwise from specimens.

The beetle figured above takes its common name from its destructiveness, in grub state, to hides and skins, on which its ravages cause severe loss in Europe, North and South America, and other parts of the world. But also it is sometimes found in vast numbers in deposits of bones, such as are collected for manufacture of bone manure, from which the grubs stray away to adjoining woodwork, and burrow into it, until (as shown by the small fragment figured above) it is so riddled and honeycombed by the infestation as to be totally destroyed. The grubs also occasionally do great harm similarly to

cork; but it is from their damage to bones and to the wood of the buildings containing them that they may be fairly placed amongst occasional agricultural pests in this country.

In the past season such a plentiful supply was sent me both of the beetles and their long hairy grubs in living and active condition, together with specimens of the gnawed bone which they had infested, and the honeycombed wood which they had completely ruined, that I had good opportunity for observation of the attack, and also by placing some of the grubs in a tube closed with a large cork I was able to watch their power and willingness for burrowing into this material.

The specimens were sent me by a proprietor of bone stores, used for manufacture of bone manure, in the south-west of England, but for obvious reasons I do not give the address.

The first communication, which was sent me on Sept. 24th, was as follows:—

"Bone Stores.—In some stores, in which I have bones stored for manure manufacture, a heap of bones has been standing for some six or nine months, and a plague of flies" [beetles rather.—Ed.] "have really honeycombed the bones, and not only the bones, but the posts, and floors over them. They have done serious damage, not only to the bones, but the stores. I herewith send specimens of the bones and the wood, as well as the flies. Can you suggest a remedy other than carbolic acid and hot water, with which I propose soaking the place?"

In reply, I gave requisite identification of the beetles and their grubs, together with some suggestions for checking attack, amongst others that of a thorough tarring of such of the woodwork, as beams, uprights, &c., to which tar could be applied; as it might certainly be expected that with these remarkably hairy grubs, any of them that endeavoured to cross a recently tarred surface would at once be stuck fast, and even the smoother and more active beetles would at least not penetrate through a coat of damp tar.

To this my applicant replied, on Sept. 29th, that he was already starting tarring the woodwork, and grinding the bones into dust, which the beetles did not seem to touch; and on Oct. 1st he further added:—"As to their food they certainly prey on the bones, which are completely riddled where they have laid for long in the centre of the heap (about twelve months). The" [beetles] "seem to propagate on spots of grease, or dirt of that nature, anywhere in the store. In cold weather they retire into holes and crevices, but when the boiler is heated and the place warm they come out in swarms, and I wash them down with carbolic acid in hot water."

In regard to the habits of this *D. vulpinus*, as preying on skins and

hides, this has been known for so many years that it is unnecessary to enter on them; but its injuries to bones and wood seem much less known of, therefore some of the very few references which I have found to this may be of interest.

At the meeting of the Entomological Society on Oct. 1st, 1890, Mr. W. H. Blandford exhibited "specimens of *Dermestes vulpinus*, which had been doing much damage to the roofs of certain soap-works in the neighbourhood of London," where he considered they had no doubt been introduced with bones.*

The late Prof. C. V. Riley, in his exhaustive paper on this infestation,† mentions having found this species under buffalo bones in Kansas; and also, p. 261:—"The pupa is sometimes found in the larval burrow, but more often the full-grown larva leaves the leather, and seeks for a crack in the box or floor, often burrowing for its length into the solid wood. In the warehouses where the goods are boxed up in soft wood, the boards are often riddled by these burrows, made by larvæ seeking for safe places for pupation. This instinct of self-preservation is necessary, as the larvæ have a fondness for the soft helpless pupæ of their own species, even when other and more natural food abounds."

A very interesting account of bad attack of *D. vulpinus* to bones and wood in Sheppey, corresponding, except in being on a much larger scale, with that sent me from Devonshire last season, will be found in the 'Entomologist's Monthly Magazine,' Dec. 1884, p. 161, contributed by Mr. J. J. Walker, Ranelagh Road, Marine Town, Sheerness.

Mr. Walker mentioned that, having heard that a bone-boiling works at Queenborough, in Sheppey, was greatly infested by "bugs," he went to examine, and found the *Dermestes vulpinus* in enormous numbers on the walls, and also in quantities which could "be picked up by handfuls under bones, bits of sacking, &c., on the floor. The foreman of the works complained bitterly of the damage done to the woodwork of the building by the 'bugs,' and showed me a thick oak plank, about twelve feet long by a foot wide, reduced to a perfect honeycomb by the ravage of the *Dermestes* larvæ. These, when full grown, had bored into the solid timber to change to pupæ, of which I dug out numbers with the point of a knife."—(J. J. W.)

Mr. Walker also noted that the bones, he was informed, came from various parts of the world, but the greater portion was brought from South America.

The figure 6, p. 17, of a small piece of the good specimens of injured wood sent to myself, gives some idea of how completely it was

* Trans. of Ent. Soc. for the year 1890, p. xxxi.

† See Report of the Entomologist, U.S.A. Department of Agriculture, issued June, 1886, pp. 258–264.

honeycombed away. From its condition I could not get a sufficient slip to make sure of the kind of wood, but it appeared to me to be certainly not pine, and much resembled oak. The offensive smell, or rather absolute stench, of the infested wood was excessively repulsive.

The figure (5) of bone shows, at the upper part, the manner in which it is burrowed into holes or cavities by this infestation.

The beetles greatly resemble, as do also their hairy grubs, the kind often met with in ill-kept larders or stores commonly known as the "Bacon" or "Larder" Beetle, but are distinguishable from it by being chiefly of a snow-white beneath. They (the *D. vulpinus*) are stated to vary from a quarter to just over half an inch in length, and of the great number of specimens sent me, those I measured were average size,—about three-eighths inch long. The shape is somewhat narrow and flattened; the general colour above brownish or greyish black, with more or less sprinkling of very short pale fine hairs, and white pubescence on the head; a broad band along each side of the thorax or fore body being much more thickly covered with longer and whiter hairs, so as to show clearly like a long white or grey patch. At the inner tip at the end of each wing-case is an excessively minute sharp spine. The body beneath is snow-white, with a row of bright black spots quite at the edge, one on each segment, "and the apical segment has its central region altogether dark, though fringed with fulvescent pile." * When the specimens are in good order, the snow-white tint beneath the abdomen with the fairly large bright black lateral spots are very noticeable.

The grubs are very hairy, and of the shape figured at 3, p. 17; average length rather over half an inch—my largest specimens were a little over five-eighths long—by three-sixteenths of an inch in diameter; subcylindrical, tapering gradually to the tail, more bluntly to the head. General appearance brown above, whitish below, excepting towards the hinder extremity, where the brown colour turns down, as it were, from the upper side, and extends beneath until, at the tail, the under surface is wholly brown; a rather brown pale yellowish line runs along the centre of the back above, and between the segments there is usually a yellowish line also; above the tail, which is somewhat bluntly pointed, are two somewhat thorn-like processes. Head dark brownish; six claw-legs (with the help of which the grubs can walk with wonderful speed) also of some shade of brown.†

I was unable to find any pupæ, which, considering the great

* 'Coleoptera Sanctæ Helenæ,' by the late Vernon Wollaston, F.L.S., p. 56.

† A long and most elaborate description of the larva will be found in Prof. Riley's paper, previously quoted, p. 264.

numbers of beetles and grubs sent me, and also that the honey-combed wood obviously must have given the ordinary shelter for them, appeared to confirm Prof. Riley's observation of the grubs having "a fondness for the soft, helpless pupæ of their own species." The figure (p. 17) shows the appearance of the pupa magnified.

The life-history (quoting from the same source) appears to be that, under special observation, the eggs hatched in from four to seven days, and the newly-hatched grubs, which at first were almost white, in a few hours took the ordinary colouring, and buried themselves in their food; after repeated moultings, the full-grown grub formed a chamber in its food material, or any other convenient locality at hand, where it curled itself up, loosely covered with bitten-off morsels of the material round it. Here it lay for six days, then moulted again for the last time, and turned to pupa (or chrysalis), from which the beetle developed in a fortnight. Under *un*favourable circumstances, the time occupied from hatching to development of beetle was found to be fifty-nine days; but it was considered that the duration of the life of the larva or grub might vary with circumstances of temperature and food from as short a period as two or three weeks to being extended over several years, as has been recorded in the case of other allied insects.*

Prevention and Remedies.—In view of damage to hides and skins (which is the chief and also very great cause of loss to us by ravage of this infestation), the above notes of retarded development, occurring from difference of amount of warmth, &c., are important; but they might be of use regarding propagation in bones. Those practically concerned might find that warmer or cooler conditions of locality of bone storage might be managed so as to lessen rapid succession of broods.

Heavily salted skins are stated (in entomological notes) to be "comparatively free from the pest; but even the poison-cured skins are not exempt from attack." Whether heavy dressings of salt might act well in clearing the pest from the bones we have no record of; and on the face of the thing, my correspondent's own application of drenching with carbolic acid and hot water seems as likely as anything to act remedially.

But though we do not appear to have any way recorded of clearing the bones, the woodwork at least might be protected where accessible. If rafters and under timbers of roof, joists and under side of plankings of floors, and all upright posts and woodwork, were thoroughly well tarred from time to time, it would be an absolute impossibility for these grubs, coated as they are with long fine hair, to gain entrance

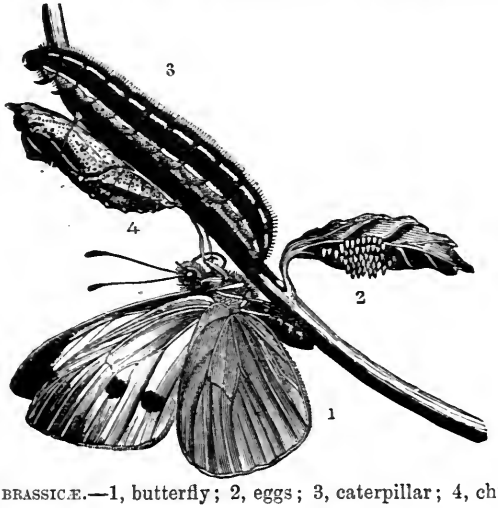
* See Prof. Riley's paper, previously quoted, p. 260 [54].

into the timbers. They could not fail to be stopped by the clinging of the wet tar by the time they had crawled their whole length on it. Also it might be expected to be a great preventive to beetles coming out from the wood through it. Tar could not well be applied to upper surfaces of floors; but where steam power was at hand, probably this applied, as hot as could be, by means of a hose, would act as well as it has been found to do in clearing maggots in cheese factories, or both here and in Canada in clearing that virulent wheat-mill pest, the Mediterranean Wheat Mill Moth.

Plastering up all crannies in which (as noted at p. 18) the beetles shelter in cold weather would do some good also; but at present we have had little report of the infestation, excepting the vast numbers in which it can appear, and also its power of complete destruction of the woodwork in the neighbourhood of its feeding localities.

CABBAGE.

Large White Cabbage Butterfly. *Pieris brassicæ*, Linn.
Green-veined White Butterfly. *Pieris napi*, Linn.



PIERIS BRASSICÆ.—1, butterfly; 2, eggs; 3, caterpillar; 4, chrysalis.

The caterpillars of the white Cabbage butterflies are amongst the most common pests that we have in garden Cabbage growing; but in field cultivation they are much less troublesome (or at least very rarely reported), probably because it is the habit of the three common kinds for the caterpillars, when about to turn to chrysalids, to choose some sheltered spots, such as under eaves, or bars of fences, or amongst boards, or in sheds, &c., which are not so conveniently at hand for the caterpillars to creep to in the fields as in garden cultivation, and consequently there are much greater numbers of butterflies to be found on garden than on field Cabbage.

From some of the agricultural enquiries sent last year, it seems possible that, though the butterflies are well known, some notes on the life-history, and especially how to recognise the caterpillars, may be serviceable for field use; also a few notes bringing such treatment as is known quite up to date.

On June 30th I received a letter from Mr. S. B. Burroughes, of Cley-next-the-Sea, Norfolk, in which he alluded to the above point,—of the caterpillars being most observable in gardens,—as follows:—

"Enclosed I beg to hand you a caterpillar, of which I found a lot in some Cabbages I am growing for next spring use. I do not remember having seen the like before,—not in a field; I have seen similar ones feeding on leaves in my garden."—(S. B. B.)

The specimens sent were caterpillars of the Large White Cabbage Butterfly, then only about half grown, but very handsomely marked with black on the greenish ground.

There are three kinds of white Cabbage butterflies, the "Large White," *Pieris brassicæ*, the "Small White," *P. rapæ*, and the "Green-veined White," *P. napi;* but these are so much alike in their habits, excepting in the method of egg-laying, that the history of the "Large White" may serve for all. This kind, *P. brassicæ*, lays its eggs in clusters or groups of from just a few, up, sometimes, to as many as fifty or sixty on the leaves,—the eggs of the two other kinds are laid separately,—and all are of a somewhat flask-shape, and are fastened so as to stand uprightly on one end.

The caterpillars of the "Large White," when first hatched, are of a greenish colour, with large black heads, and some amount of black patches and specks. With the successive moults, the caterpillar becomes of a yellower green, still marked with black, and after the fourth moult the head becomes pale. When full-grown it is about an inch and two-thirds in length, of the common somewhat long cylindrical shape figured at p. 23; of a variable ground colour of some shade of bluish or yellowish green above, with a yellow central line along the back and sides, and greenish yellow below. The body marked with large black spots, as well as smaller ones, which are separated along the back, but more or less united along the sides, so as sometimes to form almost a stripe along the sides; and the head partly black, but with the lobes bluish grey, powdered with black spots.

The attack may occur from early summer until advanced autumn; the latest specimens of the "Large White" caterpillars which I received last season were forwarded just at the end of September.

When about to change to chrysalis state, the caterpillars secure themselves to some firm object, such as a wall, or beneath the coping, or to palings, or amongst boards, by attaching the tail with threads, and passing a strong thread round the body, something like a fine waistband or belt, and thus secured from falling the caterpillar slips off its last skin, and appears, as figured at p. 23, as a chrysalis speckled with black on a pale ground, greenish or variable in tint. From this, in summer, the butterfly comes out in about a fortnight, but not till the following spring from the autumn brood.

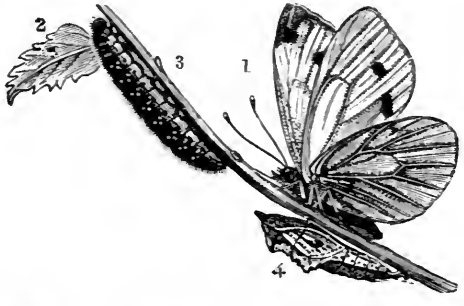
In the case of the "Large White," the butterfly is fairly well distinguishable from the two other kinds by its greater size, being about two and a half to three inches across in the spread of the fore wings, which have a large black patch at the tip.

For agricultural purposes, it is the distinctions in appearance of the caterpillars that are most needed, and those of the two other common kinds mentioned above (the "Small" and the "Green-

veined" White) are that they are smaller than those of the "Large White." They are only from just about over an inch (in the case of the *rapæ*, the "Small White") up to, sometimes, about an inch and a sixth in length (with the "Green-veined White"), and are velvety in texture, of some shade of greenish in colour, and speckled or dotted black, but without the great black blotches of the *brassicæ*, or "Large White"; and in the case of the *rapæ*, the whole skin set with small black dots down to the legs.

The chrysalids are suspended very similarly to those of the "Large White"; those of the "Small White" are stated to vary much in ground colour,—as of various shades of drab, with more or less spotting of black, also of rosy pink, or, again, of a dull green. The chief varieties of the "Green-veined White" are stated to be of a light tender green, or a very pale pink buff.*

The "Small White" butterflies are chiefly distinguishable to general observers from the "Large" species by their smaller size, but



PIERIS NAPI.—1, butterfly; 2, egg; 3, caterpillar; 4, chrysalis.

the "Green-veined White" (see figure) may easily be known by the broad greenish margins to the veins beneath the hinder wings.

On June 25th Mr. Thos. M. Henry, writing from Ballyskeagh, Dunmurry, near Belfast, Ireland, sent me an enquiry regarding a caterpillar attack, which, he noted, "is destroying my Turnips after they are singled or thinned out."

In this instance the caterpillar proved to be a very characteristic example of that of *P. napi* (the "Green-veined White"). The paler colour of the green below the larva and the white hairs showed excellently, as also the yellow rings round the spiracles. The caterpillar had passed its thread-belt round it to support it for its coming change to chrysalis; and the great strength of the thread was very

* For excellently minute account of larvæ of the above-named species, from which I quote some portions, see the elaborate record of observations in 'Larvæ of British Butterflies and Moths,' by W. Buckler, vol. i. "The Butterflies," pp. 148–159.

noticeable, for the belt not being observable without a magnifier, and wishing to remove the caterpillar from where it was resting, I found that I risked pulling the creature's head off in trying to draw it away, so strong was the thread-belt.

Prevention and Remedy.—In garden ground it cannot fail to be of service to collect the chrysalids from such localities as those noted at p. 24, and to destroy them. Whether in summer, or when in winter the hybernating chrysalids can be searched out at leisure from their sheltering places, this plan obviously must get rid of much impending local attack.

Hand-picking also is a sure remedy where, as in garden cultivation, the labour and time needed are not too costly; but this infestation is one that may come in great numbers on the wing, or be wind-borne in flocks, or may very likely appear in great numbers after a period of fine dry weather, and for field use, unless poisonous dressings are used (which I should not like myself to take the responsibility of advising), the only really fairly good plan for checking caterpillar attack appears to be the use of good strong powdery dressings, especially of lime, or of soot, given when the leaves are damp, so that the powder may adhere.

Amongst these, by looking over reports of treatment, lime seems to have been the most satisfactory for broadscale use. I have had information of it as answering well when used finely powdered and in a caustic state, and the following note, from a paper read at the Annual Meeting of the Association of Economic Entomologists, U.S.A., 1891, by Prof. John B. Smith, Secretary, is worth observation, as coming from such a good authority:—

"A number of growers have this year kept their Cabbage clear of the larvæ of *Pieris rapæ* by using lime, either fresh, air-slaked, or in the form of a dry hydrate, first sifting it, and then dusting on the plants when wet. Lime makes a good fertilizer, and almost every farmer has it. It is the simplest way we have of keeping this species in bounds." *

* 'Insect Life,' vol. iii. No. 5, p. 218. Whilst writing the above I am favoured by presentation of his new work, 'Economic Entomology for the Farmer and Fruit-grower,' by Prof. J. B. Smith. This is a convenient-sized volume, very practically useful for field work, as well as entomologically instructive, and excellently and fully illustrated, published by the J. B. Lippincott Co., Philadelphia, U.S.A.; and in this, at p. 248, Prof. Smith strongly recommends the use of Paris-green or other arsenites at the rate of about one pound to one hundred and fifty gallons of water. Of this he observes that "The amount used to a single Cabbage plant is so minute that in order really to poison a man it would be necessary for him to eat about a dozen heads, outer leaves and all, and if death then resulted, I would be inclined to attribute it rather to the Cabbage itself than to the Paris-green or other arsenite

Besides lime, we have notes (with ourselves) of soot being useful, and likewise sulphur; and, in my own practice, I have found gas-lime which had lain *exposed for eight months* (that is, from the previous November to about the 20th of July in the following year) answer very well. On the occasion observed, the "Whites" were remarkably plentiful in my own garden, and especially (after watering) on the Cabbage bed. I had most of the infested plants removed, and the surface of the bed, as well as the remaining Cabbages, dressed with about half a cart-load of the well-exposed gas-lime. On the following day the White Butterflies were very few in number on the bed, though numerous elsewhere in the garden; and so long as I continued observation, the "Whites" hardly settled on the gas-limed bed, and the caterpillar attack was well checked.

Looking at the nature of the dressings which have been practically found to answer fairly, namely lime, gas-lime, soot, and sulphur, it will be observed that they are all powder dressings, which would, if thrown when the leafage is damp, adhere very thoroughly to the upper surface of the leaves, and also, from the quantity which would fly about, would adhere to some extent to their lower surfaces, and also would act more or less beneficially to the plants.*

The above, taken in connection with the thoroughly serviceable nature of the mixture known as Fisher Hobbs's mixture, which is composed of the four above-named ingredients, suggests that a union of them in one application, and given broadcast as for Turnip Fly, might do all that is needed. The exact recipe is,—one bushel of gas-lime, fresh, one bushel of lime, also fresh, ten pounds of soot, and six pounds of sulphur, well powdered, and thoroughly mixed, and applied when the plants are damp, as early in the morning when the dew is on. The above amount is sufficient to dress two acres of young Turnip plants when drilled at twenty-seven inches, and in this case may be distributed by a broadcast machine, or by hand. With a Cabbage crop advancing towards full growth, a larger quantity would be needed, and likewise hand distribution, in order more especially to drop or throw it on to the Cabbage where, as in the case of the caterpillars of the "Green-veined White," they may be more especially found towards September, feeding, like the caterpillar of the Cabbage Moth, on the central leaves.

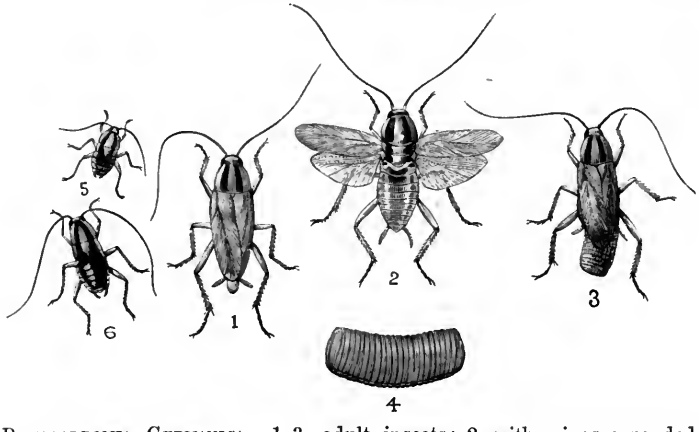
employed." But though this is obviously true, and in time probably we shall advance to using the arsenites here for field insecticides just as they have advanced in the U.S.A., yet at present I could not take on myself the responsibility of advising the above treatment, more especially as the feeling against it might probably ruin sale of the Cabbage.

* In the small quantity used, I am not aware whether the flour of sulphur would have any special effect in broadscale application.

I have not entered here on the subject of parasitic attacks, for in field culture it is most unlikely any attention would be paid to them, but perhaps it should be added that where there are little clusters of very small yellow cocoons (very like miniature silkworm cocoons) noticeable, these should *not* on any account be destroyed. They are the chrysalis-cases of a small ichneumon fly, the *Microgaster glomeratus* scientifically, of which the fly will sometimes lay even as many as sixty eggs in one caterpillar of the "Large White," and thus prevent, by the parasite grubs feeding within, the caterpillar coming to maturity.

COCKROACHES.

German Cockroach; "Croton Bug" (U.S.A.); "Steam Flies."
Phyllodromia Germanica, Linn.



PHYLLODROMIA GERMANICA.—1–3, adult insects; 2, with wings expanded; 3, female with egg-sac attached; 4, egg-sac;—all magnified; 5 and 6, young, still wingless forms. After figs. by Prof. Riley, and specimens.

Our long-established house and kitchen pest, the Common Cockroach, the *Blatta* (*Periplaneta*) *orientalis* scientifically, and popularly, though very inaccurately, known as a Black Beetle, cannot be classed amongst crop pests, neither, strictly speaking, can the much smaller kind, the "German Cockroach," figured above, although on the Continent it is sometimes found in woods. Still, as this kind has not yet established itself in this country, and if it did so, from its greater rapidity of multiplication, and its more general destructiveness than our common Black Beetles, it would be such a serious infliction, that

a figure, by which to recognise it, and some notes, consequently on enquiries sent me on its habits, as to how to get rid of the (comparatively) pretty little creature, may be of interest.

The two kinds are very easily distinguishable; our "Common Cockroach" being usually little less than an inch in length when full grown, and of a uniform dark pitchy or dark mahogany colour, without lighter stripes or mottlings, and although the males are winged, the females are wingless.

The "German Cockroach" is at full size only a little over half an inch long, and though it varies in colour, it may be generally described as of a very light or yellowish brown, with two dark stripes running along the upper surface of the fore part of the body. These stripes are very noticeable (see figure, p. 28). Also both males and females are winged.

The following note, sent me on March 19th by the superintendent of an hotel in one of our chief manufacturing towns in the north-west of England, shows the decided settlement of the infestation, as well as the trouble it is already inflicting *:—

"We are, like most other hotels, much troubled with what are known as 'Steam Flies'; . . . they herd in kitchens, &c., and lodge beneath any crevice. The only method of extermination that has any effect is to send a man (who makes it his business) in to stove them; this is not only an expense, but a nuisance. . . . They increase in an alarming fashion; the ordinary Cockroach remedies seem to be quite useless."

On May 6th, in reply to some further communication of my own, my correspondent wrote as follows:—

"I tried the 'Persian powder,' but found it only to answer the same as Keating's insect powder, which I have used a good deal. It stuns the insects only, and if not swept up and burnt, they come round again. Servants are careless, and if the dust-bin is nearer than the fire, they are thrown there, and come to life again.

"Since writing to you, I have had the kitchen, scullery, and tea-room well stoved; the sulphur" [for methods of application, see heading of fumigation further on] "has killed a great number; yet, in spite of this, we still see them running about, and as they breed so quickly, I fear we shall soon swarm again.

"They seem to be able to eat their way through the walls and the floors, and infest the wood tables in kitchen and tea-room; they get into every crevice. After stoving the kitchen twice, I was very much

* The enquiry being in business confidence, I do not publish name and locality of the hotel, but I may say it is not far from the coast, and precisely where these pests, which thrive on some of the steam passenger service from this country to America, might be likely to be found.—Ed.

astonished to find they were still alive, and coming out of the crevices of the table and in the drawers. As an experiment, I got some strong ammonia and poured in the drawers, and painted round the table with it. In a few hours I opened the drawers, and found several dozens laid on their backs quite dead. But it is very difficult to use this where food is always about, and servants are not to be trusted."

Of the good supply of very characteristic specimens sent me, almost all were fully developed, only a very few being in larval or wingless state.

The general colour is light or yellowish brown, with two brown longitudinal stripes running along the upper part of the fore body; head bent down, yellowish above; horns (antennæ) long and slender. Wings four; the upper pair (or wing-cases) narrow, and lapping over when in repose, gaping apart at the tip, and longer than the abdomen, the texture like thin parchment, the colour yellowish; the true wings folded lengthwise beneath them, and nearly as long, more transparent. Legs ochrey.*

The larva (that is, the early stage before any appearance either of wings or wing-cases) brownish, with yellowish stripe down the middle of the fore body and also along each edge, thus being darker in general appearance than the perfect insect, in which the brown colour (see figure, p. 28) only shows as two stripes; also there was a narrow yellowish edge to the abdomen.

The egg-case was, as usual with Cockroaches, a kind of horny sac, which is so gradually forced out with its contained eggs by the mother insect, that it may be carried about (as with our Common Cockroach) for several days before deposit. The figure 4, p. 28, shows the shape of this egg-capsule, which is somewhat squarer at the ends than that of the Common Cockroach, and under a fairly strong magnifier shows as definitely, transversely striated; and along one side runs a raised ridge, minutely toothed, or rather, in this species, beaded, which opens longitudinally, thus forming the two edges of a long slit, through which presently the young Cockroaches, after hatching from the eggs contained in the case, push their way out.

In regard to localities and nature of food. The presence of these pests is not limited to indoor shelters, for Dr. Taschenberg notes them as having been found repeatedly in German woods; also that he has himself captured them in the woods near Halle, and he was aware likewise of their having been taken in woods near Leipzig.† Indoors,

* For technical description of characteristics of the family of *Phyllodromidæ*, also genus *Phyllodromia*, and species *Germanica*, the reader is referred to the 'Blattariæ of Australia and Polynesia,' by G. O. Tepper, F.L.S. (separate issue from Trans. of Royal Soc. of South Australia), pp. 35 and 41.

† See 'Praktische Insekten Kunde,' by Dr. E. L. Taschenberg, pt. iv. p. 210.

the infestation is especially to be found in kitchens; and it is noted by Prof. Riley that "its small size enables it to hide and breed in cracks into which the Oriental" [our Common Cockroach] "or American Roaches could hardly push their front feet." Also regarding methods of spread of the infestation, the following note, taken from the same paper by Prof. Riley, is well worth noting. Speaking of this German Cockroach, known in America as the "Croton Bug," he says:—

"It is also a European species, and derives its common name from the fact that its first appearance in force in this country was synchronous with the completion of the Croton system of waterworks in New York city. It had in all probability been brought over many years before, but had remained comparatively unnoticed until the extension of the waterworks, with their numerous pipes in all residences and places of business encouraged rapid spread and multiplication; for this species is more fond of water than . . . and is often carried by pressure through water-pipes without injury." *

In regard to food or drink, this species appears to take almost anything,—beer or oil amongst drinkables; and amongst eatables "anything that comes on table," blacking off boots, ship's biscuits—in fact, materials far too numerous to specify.

The species is widely distributed over many parts of the world, and it has long been in this country, for under the name *Ectobius Germanicus* it is recorded in 1835 by Stephens † as having been found about and in London, Portsmouth, Plymouth, &c.

In 'Household Insects,' by Edw. A. Butler, the writer, at p. 146, records this species as one that "is known all over the United States, and sometimes gets a footing in London; and that in a baker's shop at Leeds it established itself," and was supposed, from circumstances detailed, to have come from the Crimea. I have myself had great complaint of it as infesting a line of steamships plying between the north of Ireland and the United States of America, where the pests particularly established themselves in the warmest quarters they could find, and at night, in their maraudings, showed especial fondness for the remains of wine or beer that might chance to have been left in glasses from the passengers' tables.

Prevention and Remedies.—The point which of all others requires attention in endeavouring to get rid both of this and also our Common Cockroach, is that the *apparently* dead insects should be made surely so. They have enormous powers of vitality, and though they may appear to have been drowned in beer, or stupified by insect powders

* "Cockroaches," by C. V. Riley. 'Insect Life,' of U.S.A. Department of Agriculture, vol. ii. No. 9, p. 267.

† 'Illus. of Brit. Entomology: Mandibulata,' vol. vi. p. 46.

of various sorts, yet nothing is more likely than that presently they will recover, and then, if they have only, as often happens, been thrown into the dust-bin, they will fly back in the case of the little German Cockroach, or creep or fly back according to whether they are males or females in the case of our common kind, and all the trouble of trapping will have been wasted.

For ordinary remedies, not needing special care or expense, I have found Hardiman's insect powder answer as well as could be wished for getting rid of the Common Cockroach, and probably this or Keating's, or many other insect powders, would all answer in lessening also the numbers of the smaller Cockroach, if applied by being thoroughly blown into all accessible crevices last thing at night, when the rooms were about to be shut up. But this only where the apparently dead insects are swept up and burnt or scalded, or in some way quite certainly got rid of. Borax scattered in powder at night on a kitchen floor also answers; and so does a trap of a little beer, or beer and sugar, placed at the bottom of a bowl, with a few pieces of stick set slanting from the floor, and supported at the upper end against the bowl. These make roads by which the "roaches," large or small, can travel upwards, and when at the top, fall into the beer below, and become temporarily so stupified that they may be destroyed without further trouble than throwing them into the fire.

But from some reason I do not understand, it has appeared to me that, after a few nights' use of any special remedy, the Cockroaches (even though they were not all destroyed) in some way found out that the trap, or powder, was to be avoided, and did not come within its influence, so that it was desirable to change the plan.

In Prof. Riley's paper, referred to at p. 31, the following passage is well worth notice:—

"Without condemning other useful measures or remedies, like borax, I would repeat here what I have already urged in these columns, *viz.* that in the free and persistent use of California buhach, or some other fresh and reliable brand of Pyrethrum or Persian insect powder, we have the most satisfactory means of dealing with this and the other roaches mentioned. Just before nightfall go into the infested rooms and puff it into all crevices, under base-boards, into the drawers and cracks of old furniture,—in fact, wherever there is a crack,—and in the morning the floor will be covered with dead and dying or demoralized and paralysed roaches, which may easily be swept up, or otherwise collected and burned."*

In regard to stopping cracks, such as those by hearthstones, through which the Cockroaches come up, and which at times not

* See "Cockroaches," by Prof. C. V. Riley. 'Insect Life,' U.S.A. Department of Agriculture, vol. ii. No. 9, pp. 266–269.

being deterred from continuing traffic through by the use of ordinary plaster, make some stronger preventive necessary, I have found it answer to fill these with plaster of Paris mixed with a weak solution of sulphate of copper, sometimes known as blue vitriol, or blue-stone. I mixed a very little of the plaster at a time in a common sized tea-saucer, and with a flexible paper or palette knife filled in as much of the crack as the plaster would reach to as quickly as possible, then washed the saucer (that the setting of the next mixing might not be spoiled), and so proceeded, mixing fresh and filling, until the cracks were stopped. If a few little bits of the blue-stone were left in, it was all the better. The plan is a little troublesome, but I found it to answer well when I carried it out myself.

In the following note, kindly given me at my request as to how the "stoving," mentioned at p. 29, was carried out, it will be observed that a mixture of carbolic acid with limewash was applied to the walls as one of the operations after the fumigation, and doubtless the carbolic acid might be utilized as a deterrent of Cockroach travelling through, or sheltering in, crevices:—

Fumigation.—"The stoving process destroyed a great number of the little Steam Flies, as I call them, but does not exterminate them entirely. Keating's insect powder is also good, and stuns them, but they must be swept up and burned, or they come round again. I had the joiner to come to stove the kitchen and scullery two nights, using about eight pounds of brimstone each night. Of course, before 'stoving,' he pulled down all wooden shelves and casements that might be protecting gas or water pipes; then, of course, made up all crevices in doors and windows, also fireplace. After that I had the walls limewashed, *and* put carbolic acid into the lime*; and I must say, after all the trouble, we had very few of the vermin left. I did not see the man stove the kitchen; but I believe the sulphur is put upon an iron plate,—over shelves, for instance,—or an old pail in the middle of the room where it is to be used, and then set fire to, carefully pasting up every crevice of the door when you come out of the room."

The following note on a safe and simple method of preparing sulphur fumes, taken from a pamphlet on 'The Flour Moth,' issued by the Ontario Board of Agriculture, may be of service:—

"To prepare sulphur fumes: place a metallic dish containing hot ashes on some support in a pan of water; or place in an old pan, or other vessel, a bed of ashes at least six inches deep and about fifteen inches in diameter, and place the sulphur and saltpetre in a slight depression in the centre, and ignite. The proper proportions are:

* The italic type is my own addition to draw attention to the mixture.—Ed.

three pounds of sulphur and three ounces of saltpetre per 1000 cubic feet of air space. All doors, windows, and other openings should be tightly closed before the sulphur and saltpetre are ignited. . . . Chlorine fumes may be used with equal benefit where burning sulphur may create an added element of danger from fire. . . . To prepare chlorine fumes: mix in a glazed dish and place on a stove or other heating surface, peroxide of manganese, one part; sulphuric acid, two; chloride of sodium, three; water, two; or more easily by mixing three pounds of chloride of lime and three pounds of hydrochloric acid for every 1000 cubic feet of space." *

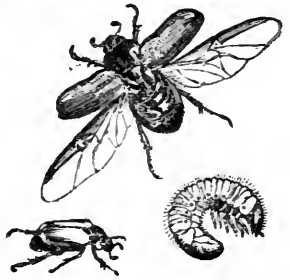
The above recipes were recommended as remedial applications for destruction of the very destructive (and difficult to destroy) mill pest, the Mediterranean Flour Moth, and may be confidently expected to be of use in all cases of fumigation. But perhaps it may be but right to suggest to house-owners, and those who may need to use these remedies on the small scale of kitchen use, that it is very desirable they should only be used by trustworthy hands; and also, as it is perfectly incredible to what lengths stupidity or misunderstanding may sometimes be carried, that they should very carefully see that the operator does not shut him- or her-self up as a preliminary, with possibly most serious consequences.

But whether for our common kind or the little German Cockroach, it cannot be too clearly borne in mind that drowning or any moderate stupifying of the pests is probably time and money thrown away, unless the apparently *dead bodies are burned, or in some way or other quite surely destroyed.*

* See Bulletin 1, Provincial Board of Health of Ontario, "The Flour Moth, *Ephestia kuhniella*," issued by the Ontario Department of Agriculture, 1889, pp. 12 and 14.

CORN AND GRASS.*

Rose Chafer. *Phyllopertha horticola*, Linn.
Cockchafer. *Melolontha vulgaris*, Fab.



PHYLLOPERTHA HORTICOLA.—3, beetle, nat. size; 4, with wings expanded, magnified; 5, grub, magnified.

During the past year, enquiries regarding chafers (which have been so frequently recorded as mischievous of late years) occurred at intervals from February 21st to October 8th. Last year four species were noticed; in the past season the only kinds reported were the Cockchafer and the Rose Chafer, and chiefly the latter; and it will be seen that though we still need to know very much more as to methods of keeping these attacks in check, still some small amount of useful information has been gained.

The first observation was sent me on February 21st from Detmore, near Cheltenham, by Miss Dobell, whose grass-land has suffered so much in previous years from both of the above-named kinds, that she has bestowed great attention on the subject. This year, speaking of the grubs, without distinguishing which species she then referred to, she mentioned, on February 21st:—

"I have done nothing to the grubs, as the moles have been working so hard at them that I did not like to put anything that would kill them. No frost seems to hurt the grubs; and where the moles and chickens and birds have not been, they are as thick as ever."

One of my first communications, however, regarding presence of Rose Chafers in beetle state during the past season was sent me on June 10th from Hazelhurst, Haslemere, Surrey, by Mr. T. P. Newman,

* Many enquiries or communications have been sent in the course of the past season regarding common Corn and Grass attacks, as Corn and Grass Aphides, Daddy Longlegs, Wireworm, Gout Fly, &c.; but as the histories of these, with all known means of prevention and remedy, have been repeatedly entered on in these Reports, the reader is referred to these accounts, or other accessible publications, instead of again entering on the details.—E. A. O

who has paid much attention to the attack in this stage in previous years, and who wrote as follows:—

"The Rose Chafer is not so numerous, however, as in past years, and now a few hundreds a night are a good haul."

Mr. Newman further mentioned information from a neighbour:—

"That he spread soot over a piece of grass that had been infested while the beetles were flying. Next year that grass was greatly improved, and he says that the soot drove away the chafers, and prevented them laying their eggs."

This is a very good observation, which might be utilized by application, not only of soot, as above-mentioned, but of such dressings as lime, or mixtures of lime, which might take away the attractiveness of the grass at the time of egg-laying, and possibly prove injurious to the grubs when newly hatched from such eggs as might be deposited.

I was also favoured on July 3rd, by Mrs. Beveridge, with some interesting notes from Pitfold, Shottermill, Surrey, a locality also very near Haslemere. After speaking of attacks of Winter Moth caterpillars in 1895 and 1896, whereby the fruit trees were stripped bare in blossoming time, Mrs. Beveridge remarked:—

"In both years we have also been plagued by the Rose Beetle. One swarm arises from a field adjoining our Rose garden, another from a wood, and this has done great harm to the few Apples and Pears which the Winter Moth had missed. We picked the beetles off the Roses eight or ten times a day both years, and are hoping we may have effected something for next year. . . . We gathered, in some hour and a half (by shaking the fruit trees over a sheet, rolling it up, and shaking the beetles into a stable bucket), more than half a bucket of solid beetles. These and most others, after scalding, we gave to our fowls.

"At the height of the season I cut off the heads of Roses in which were several beetles, and took the flowers and contents to a family of young pigs. It was amusing to see the pleasure and excitement of the hunt for the living beetles. I shall, if I can manage it, place our pigs in the field from which the beetles rise next year, and enlist them in the service. If I can find grubs underground, I shall try turning the pigs (without rings) into that infested patch, and letting them turn it up.

"I observed, in the Rose garden, that a tree which I had syringed for Green Fly with soapy water became covered with beetles. It was a veritable trap to them. I also noticed that underneath it there were subsequently many dead beetles. I saw none dead anywhere else. The water was mixed with washing soap only; in the time of our great drought all available water being saved for the garden. I should perhaps say that the syringed Rose tree was the only moist spot in

the garden, and I fancy that in the sunshine it must have made a dampness in the air around it such as all insects seem to love."

In reply to my enquiry whether the soap used was of any particular sort, Mrs. Beveridge kindly wrote as follows:—

"The soap which was in the water (with which I syringed a Rose bush, under which, later in the day, I found many dead Rose Beetles) was unscented Pears' soap. I will, if it is in my power, try next year some experiments with this and with soft-soap."—(A. L. B.)

Mrs. Beveridge's careful notes give two or three useful points for consideration: one, the fact of the chafers coming in both years to infest the garden from the same neighbouring breeding grounds; another, the fondness of pigs for the beetles, which, like many other similar facts, though we may have them on record, it is always desirable to have fresh, live examples of; and thirdly, the very great numbers in which the Rose Beetles were attracted to the bush syringed with soapy water, followed by many dead beetles being found beneath this bush and none found dead elsewhere. In whatever manner the soapy water may have acted, it is at least serviceable to know of a way in which the beetles may be attracted together in hot weather; and though, as Mrs. Beveridge added in her letter to myself, she would experiment again, "as she would not like to base an opinion on only one year's observation," this may have given us a clue to attracting the beetles by soap and water, which would act still more surely for a little of some insecticide, Paris-green, for instance, being added.

During the summer I had not many observations of chafers, but with September they again occurred. On Sept. 8th a packet of grubs of the Rose Chafer, *Phyllopertha horticola*, was sent me by Mr. J. T. Brown (sub-editor of 'The Cable'), on the part of the Earl of Winchilsea, with the request that I would identify the pest, and name means for preventing its ravages, as a field of grass laid down two years previously had suffered considerable damage from its inroads.

On Sept. 14th Mr. G. S. Ware wrote me from Eriswell, Brandon, regarding grubs sent accompanying, of which he remarked:—

"They are doing a lot of damage to the newly set Rye and Mustard. They are to be found amongst all old layers."

The samples sent proved to be Rose Chafer grubs, not yet full grown; and with the power, possessed by this kind of grub, of straightening itself out from the curved shape, lying on one side, in which it so much resembles a young Cockchafer grub, and resting on the lower surface in the common larval manner, walking along with the help of its three pairs of claw-legs, at a fairly quick pace.

On Sept. 17th Mr. Ware remarked:—

"I suppose the Rose Chafer is much the same insect as the 'Choovie'? We find that rolling with our heaviest roller has the

effect of hindering their progress very much; but the Rye has been bitten off by them in such large patches that it has become necessary to plough up the crop and re-sow."—(G. S. W.)

The "Choovie" or "Chovie" is one of the many local names given to *P. horticola*, enumerated by Curtis in his 'Farm Insects' (p. 509), as also Field Chafers, May Bugs, Bracken Clocks, Fern-shaw Beetles, &c. The observation of Mr. Ware with regard to heavy rolling being serviceable in preventing the grubs travelling in the soil, is well worth observation.

On Sept. 30th Miss Seagrave, in a note from Oakhurst, Sunninghill, Berks, requested information as to how to get rid of Cockchafer grubs, which were in such numbers beneath lawn grass, that, though the thrushes, blackbirds, and starlings helped by digging them out, something further was needed as a means to get rid of them.

On Oct. 8th Mr. Chas. E. J. Esdaile, of Cothelstone House, near Taunton, desired information regarding the best way of getting rid of a grub, which he was informed was that of the Cockchafer. He observed:—

"It has established itself in my park, and destroys several acres of grass. The rooks follow it, turning up the grass, which dies. . . . The farmer who rents the after-grass complained so of the damage, that I had to make him an allowance."

On applying to Mr. Esdaile whether he could ascertain the species, he was good enough to write further:—

"The grub that is doing so much mischief is that of the large Cockchafer; so far as I can judge, I do not think the grub has come to its full size yet. . . . I tried rolling last year without any apparent effect. I am going to try dressing an acre with two cwt. nitrate of soda and forty bushels of soot, and will let you know the result."—(C. E. J. E.)

Looking at the main points of the different above observations in abstract, we find rolling with "the heaviest roller" to be useful in preventing the chafer grubs travelling in the ground of tilled fields, as of Mustard and Rye, but not on park grass-land; also moles to be found decidedly of use in keeping the grubs in check, as well as rooks, thrushes, blackbirds, and starlings, and amongst domestic fowls, chickens. The fondness of young pigs for the beetles was also observed. Amongst methods of prevention, the use of soot thrown on infested grass, "when the beetles were flying," is well worth notice; this being followed by lesser presence of chafers in the following year, presumably from egg-deposit having been less. We have also observation that where destruction of the beetles had been well carried out for several years, of there being in this past season a decidedly lesser number; and another note yet tells of the attraction to the chafer-

beetles in a time of drought of a syringing with soapy water, so that the bush was so covered with beetles that it became a veritable trap to them, and presently many were found dead beneath the bush, although no beetles were found dead elsewhere. All these points appear to me to be useful in themselves; and in some instances, especially as to the application of soap and water, to be treatment which might be amplified at a paying rate for use on infested grass-land at beetle time, as well as in gardens.

The Rose Chafer may be recognised at a glance by its likeness to the figure at p. 35, as a small beetle, rather flat in shape, about half an inch long; with the head and fore body bright green; and the wing-cases bright brown or tawny.

The larvæ are small fleshy grubs, which lie on their sides in repose very similarly to those of the Cockchafer; but when disturbed, can straighten themselves, and creep along (as I have found by timing rate of progress by the second-hand of my watch) at from five to six inches in about half a minute. They are somewhat yellowish in colour, with chestnut or ochrey heads and jaws, the latter darker at the tips; and are furnished with three pairs of legs on the fore part of the body. They turn to chrysalids in the ground, from which the beetles come up early in the summer. The whole life from egg to beetle state does not extend, so far as I can find (reliably) recorded, beyond the period of one year.

This infestation does great harm in maggot state below ground,—most especially by feeding at grass-roots in meadow- and park-land; and in beetle state by feeding on leafage, and likewise being especially partial to Rose-blossoms, whence it is known as the "Rose Chafer."

The Cockchafer,—which is only incidentally mentioned above, because in a few observations where the grubs were mentioned as of

Larva, or grub, and pupa of Common Cockchafer.

various sizes, or as resembling young Cockchafers, and I had not specimens sent for examination, both species may have been present,—is too well known to require description. Its great grubs live for about four years in the ground, feeding on roots of grass, field crops, &c.; and even sometimes doing great mischief to roots of young seedling Firs, by gnawing the bark from the main root.

The above figure shows the shape and size, when full-grown, of

this thick fleshy larva, and its usual position,—that is, lying on one side, and more or less curved. In colour it is of a dirty white, with a rusty shining head, and three pairs of pale rusty legs; the terminal portion of the body is inflated, and tinted with grey or bluish colour, from the collection of food within showing through the skin. When full-grown the grubs go deep down into the ground—even as much as two feet—to turn to the pupal state, from which they come up as chafer-beetles in the fourth summer after they were hatched.

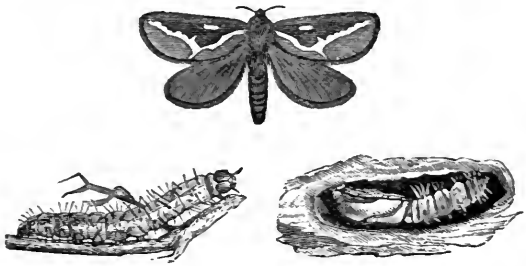
For getting rid of both of the above attacks in beetle state, the best treatment is to shake or beat them down on to cloths and destroy them; or with the Rose Chafers, where the infestation is more in reach, hold something below, and tap the blossoms so as to induce the beetles, which are easily alarmed, to fall. An especially useful vessel for this purpose has been found by Mr. Newman during attack on the Roses in his own garden to be a small fish-can: "In case they are lively the lid is shut down on them." For these beetles evening is the best time for clearing them, as then they are sluggish. With the Cockchafer also, the beating down should be done when the beetles are most torpid, as early in the morning, or on raw ungenial days.

How to get rid of the grubs in grass-land is still a difficulty which we need further information about; and even amongst field crops, where the land is more open, we can do but little against them, except such palliatives as not allowing the larger wild birds, which will seek them greedily, to be driven off, and when the ground is empty, well disturbing it to throw them out to wild birds, pigs, fowls, hand-picking by children, or weather influences.

Even from the United States of America, where we find constant help in keeping injurious insects in check, the most recent information regarding a beetle very similar in its habits only gives us the following from the well-experienced writer:—

"Frequent rotation and fall" [autumn] "ploughing are to be recommended; and where grass-lands are infested, heavy top-dressings of kainite and nitrate of soda have proved beneficial. Wherever ploughing is done in infested fields, chickens should be encouraged to follow in the furrow, and pick up the grubs."—('Economic Entomology,' by John B. Smith, Sc.D., Professor of Entomology, Rutger's College; J. B. Lippincott Company, Philadelphia, 1896.)

Small or Garden Swift Moth. *Hepialus lupulinus*, Linn.



HEPIALUS LUPULINUS.—Moth, caterpillar, and chrysalis.

The Small or Garden Swift Moth is a very common insect; but in caterpillar state it is seldom reported, although, when it does appear, it has a power of doing mischief, truly described by John Curtis long ago, as scarcely equalled by the Surface Grubs. This is one of the attacks which really is much influenced by weather. The season of ravage is autumn, winter, and spring, and though we have no record of cold killing these grubs, it keeps them quiet; whereas in an open winter like that of the early part of the past year (1896), they can creep about in the unfrozen ground and feed as they please.

In the year 1885 I had a marked observation of the powerful effect of weather on them, notes being sent me from near Bishop's Stortford in the early spring of destruction to a crop of strong healthy winter Beans, by means of these grubs gnawing the stalks in two a little below the surface to such an extent that the grower feared about two acres of the twenty were hopelessly ruined. This showed the activity of the caterpillars; but on an investigation being made on the morning of March 10th, *which was frosty*, it was found that some of them had gone down quite deep into the solid ground.

In our ordinary seasons there would be many periods between the beginning of November and March when the frost-bound state of the ground would free us temporarily from the ravages of at least this pest, and I conjecture this to be the reason why its presence is so very seldom noticed. I am not aware that since 1885, now eleven years ago, I have had any observations of these Garden Swift caterpillars worth record until the open season of the early part of 1896 allowed them freedom of movement.

The caterpillars feed at the roots of many kinds of crops; and as the moths are especially recorded as to be found at laying time hovering over grassy places, I have placed this year's notes amongst Grass pests; but Strawberry, Raspberry, Potato, Lettuce, and Parsnip; amongst garden plants the Snowdrop and the Auricula; amongst

weeds very especially the "Horehound," *Ballota fœtida*, and "Dead Nettles," *Lamium album* and *L. purpureum*, and doubtless many other plants, are subject to attack at their roots, besides the roots of Grass.

On January 24th, specimens of this attack were sent me from Harbledown, Kent, with the information that the grubs were found at the roots of the sender's Strawberry plants, which they killed by eating holes in the stems. In this case the caterpillars were full-grown (see figure, p. 41), and the only practically available remedy seemed to be hand-picking.

On February 20th I was favoured with the following notes, with specimens accompanying, from Mr. J. Acheson Lyle, The Oaks, Londonderry, Ireland:—

"My gardener has been lately breaking up a plot of ground, which, after Prickly Comfrey, has lain ten or twelve years in grass, with a view to planting early Potatoes, and we find a number of grubs of the white sort enclosed."

The samples enclosed were of Garden Swift caterpillars, of various sizes up to full growth. The largest specimens were well fed and active, but some of the others were so much injured as to suggest that they had been preyed upon by their companions during transit.

No more enquiries were sent regarding this species until Oct. 2nd, when caterpillars (of course from the summer brood) were sent me by Mr. William Rand (farm bailiff), Pickering's Farm, Bendish, near Welwyn, Herts, with a request for information regarding the grubs, as the Clover leys which he was then ploughing up were covered with them.

These specimens appeared to be of the same kind above noticed, but only one caterpillar was alive. Four others appeared to have been sucked to death, being variously gnawed and eviscerated. The survivor was full-grown and apparently in excellent health, a fact which I have often noticed in the case of the Surface Caterpillars, which (when food falls short during postal transmission) are not unfrequently in the habit of feeding on one another, the survivors being usually remarkable for being well filled out and shiny.

On November 10th, when this sheet was in type, I received specimens of similar caterpillars to the above from Mr. Geo. Hewison, of Warkworth, near Banbury. These were of various sizes, from about half to nearly full grown, and appeared quite in active condition. It was noted that they were found in the surface soil where the land had been ploughed for Wheat after Peas; and that the soil of the field where the caterpillars were most numerous was a red loam.

The caterpillar is of the shape figured at p. 41 when full-grown; about four-fifths of an inch in length; cylindrical; white or yellowish white, with the head and the plates or collar on the segment next to

it of some shade of brown; and the usual dots on the body (as I had found them in Mr. Acheson Lyle's largest specimens) of a pale yellowish tint, each of these with a stiff black hair; and the spiracles black. Earlier in their lives, the four dots on the back of each segment after that next the head are dark. The caterpillars are sixteen-footed,—that is, with three pairs of claw-feet on the segments next the head, four pairs of sucker-feet beneath the body, and one pair beneath the tail. They are somewhat variable in colouring, even to being entirely without any tint on the spots.

The chrysalis is of a somewhat long cylindrical shape, as figured at p. 41; shiny and very sensitive; and in colour of some shade from ochreous to pale reddish brown, darker on the head and wings; and showing the shape of the forming moth and of the legs and wings within it very clearly.

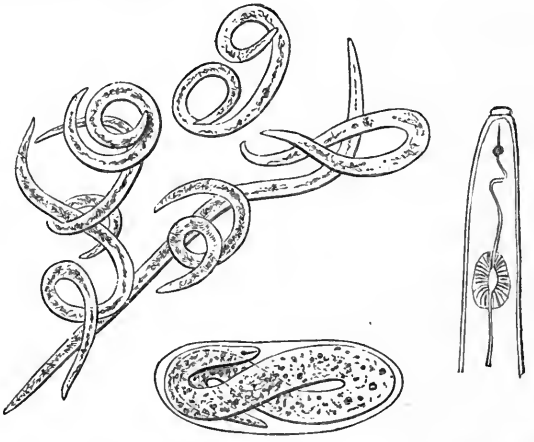
The moth is variable, both in size and colouring; the spread of the fore wings may be from an inch to an inch and a half; and the colouring may appear wholly of a dirty pale brownish, or, if characteristic, be of a clay colour or pale brown, "with a whitish streak from the base towards the inner margin, and an interrupted whitish streak from near the inner margin to the apex."

The moth appears about the end of May to the middle of June; the caterpillar is to be found from the end of September until April, and towards the end of April or in May it turns to the chrysalis.

Whether anything can be done at a paying rate to get rid of the grubs does not yet appear. In garden ground, hand-picking might answer, for children could be employed at a small cost, and under superintendence. Trapping might very likely do good, by arranging the baits of pieces of Potato, or Parsnip, or anything the grubs were found to prefer to the crop they were ravaging, in the same way as in garden trapping of Wireworm,—that is, passing a stick through the bait, so as to show where it has been buried a little below the surface, and every two or three days raising the bait, clearing the grubs, and reburying the piece of Potato, or whatever it may be.

Where circumstances admit of disturbing infested ground in winter, so as to throw the grubs open to cold, or alternating cold and thaw, this would get rid of great numbers.

STEM EELWORMS. — "**Tulip-root**" and "**Segging**" in Oats, "**Stem-sickness**" in Clover, caused by **Stem Eelworms,** *Tylenchus devastatrix*, Kuhn.



TYLENCHUS DEVASTATRIX, Stem Eelworms.—Anterior portion of female showing mouth-spear; and embryo in egg; all greatly magnified: anterior portion magnified 440 times. From figures by Dr. J. Ritzema Bos.

During the past season I have had more communication than usual about Stem Eelworm attack, including in the observations damage to Oats ("Tulip-root" and "Segging"); to Clover (Clover "Stem-sickness"); and also to Onions (the "Onion-sickness" of Holland). All of these attacks are caused by one kind of Eelworm, scientifically *Tylenchus devastatrix*.

In the case of the Onion attack, although it has long been the cause of great loss to Onion growers in Holland, and in all probability has been doing mischief here, and one at least of the unexplained causes of Onions "going off," yet it has not until the past summer been identified as one of our own crop pests; therefore, to attract attention to it, I have placed the details of the attack separately under its own crop heading of "Onions."

With regard to Eelworm attacks to Oats and Clover, though it is well known that when Eelworm is established in any special field it will attack year after year (or at a distance apart of several years) any crop put in which is liable to its infestation; yet this certain fact is so much overlooked in common field cropping, that I have particular pleasure in being allowed to give the observations of such a well-known and skilled agriculturist as Mr. Clare Sewell Read as to sequence of attacks, in addition to the others referring to the Clover and Oat attacks separately.

The first enquiries which I received during the past season regarding what proved to be Clover "Stem-sickness" were sent me on March 25th by Mr. Martin J. Sutton, from Kidmore Grange, Caversham, on the part of a correspondent near Sawbridgeworth, who had applied to him for information regarding "the cause of failures of Clover this year." The details were as follows:—

"On April 20th last year" [1895] "I drilled ten pounds of best Giant Hybrid Cow Clover in a field of thirty acres amongst a strong plant of Wheat. The preceding crop was a heavy one of *Trifolium incarnatum*. Neither the *Trifolium* nor Wheat had any manure. The land for Wheat was twice steam-cultivated. The Clover stood the drought of last spring well; and after the Wheat was harvested the Clover appeared vigorous, and continued to do so until Christmas, since which time it has gradually died off, so that now there appears not to be half a crop left.

"As the winter was mild, it cannot be attributed to frost, and there is no insect at work. The land contains plenty of lime and potash, and the field has not had Clover since 1884. The soil is a good clay loam, and is well drained with pipes. The Wheat crop was a good one, over five quarters per acre. . . . I may mention that I have heard of many cases of failure in this neighbourhood."—(Per favour of Mr. M. J. Sutton.)

The specimens forwarded were characteristic examples of Clover "Stem-sickness," caused by *Tylenchus devastatrix*, or Stem Eelworm. The shoots were much stunted and distorted in growth; the terminal bud flattened and swelled, and the rest of the shoot much beset with scales. As many as about a dozen deformed shoots, ranging from three-quarters of an inch or less in length up to about an inch and a half, were to be found, making a kind of crown to the roots; and within I found the Eelworms, some full-grown, and others of various sizes, ranging down to about a quarter of the full size.

The Eelworms, *Tylenchus devastatrix* scientifically, are just like very minute eels, of the shape figured at p. 44, and still more magnified on the Plate, showing specimens taken from infested Onions, accompanying the paper on "Onion-sickness." They are of exceedingly small size, namely of only one-twenty-fifth of an inch in length, and one-thirty-second part of their length in width. They belong to the division of the *Nematodes*, or Threadworms; and the *Tylenchi* are to some degree distinguishable by having within the gullet, or œsophagus, a long process called a spear, placed on a three-lobed base (see figures, p. 44); they multiply by eggs; and the eggs, wormlets, or larvæ, and the males and females, may often be found together in infested plants,—it may be in parts of the diseased growths or swollen leaf-buds (in the case of Clover), or very frequently in the brown or

ochrey powdery matter within the stems which are perishing from the presence of these *Stem* Eelworms.

But as other kinds of Eelworm, in themselves doing no harm, are often present with them or in the attacked plants, and are quite indistinguishable from them except by very skilled observers, we have mostly to rest for certainty as to the nature of the attack on the peculiarities of the deformed growths, which are quite enough for all practical purposes.

In the case of Clover "Stem-sickness" in the early part of the year, the circumstance of the stalks and branches being shorter and thicker than in healthy growth, and the buds also themselves being much thicker in shape, is characteristic of attack, and probably various of the stalks and branches will be found dying or decaying; and the Stem Eelworms may be found both in young and mature state in the plants, and very numerously in the buds.

Later on in the season, when the plant is in its summer growth, the characteristic malformations are very observable; and I append my own description of a bad infestation sent me in July, 1887, from the Experimental Farm, Woburn, as in this case I had the advantage of the specimens being carefully examined by Dr. J. Ritzema Bos, now Director of the Phytopathological Laboratory at Amsterdam, and likewise by Dr. J. G. de Man, of Middleburg, and of their skilled identifications of the Eelworms present being *T. devastatrix*, and the cause of the peculiar growths.

In these specimens some of the stems with flowering heads were still to be found, but also there was a large number of short barren shoots about an inch long, oval in shape, and with the distorted growth of leaves then merely forming an imbricated or "tile-like" exterior. These shoots were placed closely together, apparently from the growth of each shoot having been stopped.

They varied in number; sometimes as many as five grew on an inch length of stem, one at the extremity and two at each side below, so as to form together a flat, fan-like mass. I did not find that they grew round the central stem. They were not all similar in form of diseased growth, but were commonly irregularly and oval or somewhat bulb-shaped; but sometimes they were much prolonged, so as to resemble what is known as a "Duck-necked" Onion in shape; and sometimes the lower part of the flowering stem was enlarged for an inch or two at the base. In various of these shoots I found the Eelworms present up to numbers which might be described as "swarming" in the palish brown powdery, or rather granular matter in the hollow near the base, or other parts of the perishing shoots.*

* See my 'Thirteenth Annual Report on Injurious Insects,' pp. 3, 4.

In the case of Eelworm attack to Oat plants, the diseased growth is known as "Tulip-root," or as "Segging," or "Sedging," according to whether the base of the Oat-stem is swollen so as to resemble a Tulip-bulb in shape; or the leaves are so modified in shape, especially in the waviness of their edges, as to resemble those of some kinds of Sedges.

"Tulip-rooted" Oat plant

In the "Tulip-root" form of disease, the swelled base of the stem has usually a number of small swelled doubled-up shoots, pale in colour, and curved to and fro, growing from beneath it (see figure). This is a common and very well marked form of Eelworm disease. The "segging" is perhaps not so well marked, still the general likeness to the Sedge-leaf, and especially (where the development takes place to any great extent) the "crinkled" or waved edge of the leaf is a sufficient guide to the nature of the attack.

The following notes refer to some very characteristic specimens of both "Tulip-root" and "Segging" in Oats, sent me on May 13th, from Lawrence End, Luton, Beds, by Mr. George Oakley, who wrote as follows:—

"They were sown in February, came up strong and well, but have gone off all over the field. I gave them a dressing of nitrate of soda and salt, but the drought has prevented it doing any good. The Oats were sown after a fallow fed off by sheep; but the adjoining field, sown the same day, and the same seed, after a crop of Wheat, looks as well as I could wish. I can find no Wireworm; and as this field went off in a similar way about six years ago when Wheat, I am anxious to find out the cause."

On May 21st Mr. Oakley wrote further:—

"The eels do not seem to be working now, as the Oats they have left are growing, but the field presents a very patchy appearance. It was thoroughly cleaned last spring, deeply cultivated and harrowed by steam, and was so dried through as deep as the soil went * that one would have thought all animal and vegetable life must have been destroyed. There was a good crop of Cole-seed fed off in the autumn by fatting sheep. I may say that the same parts of the field have gone off in a similar way before; in 1891 it occurred in the Wheat badly, but the Red Clover the next year was an excellent crop."—(G. O.)

* Unfortunately the genus *Tylenchus* is one of those of which it was noted by Dr. Charlton Bastian that they possess "a remarkable tenacity of life and power of recovery after what seems to be complete desiccation."—('Monograph of the Anguillulidæ,' by H. Charlton Bastian, 1864, p. 85.)

In the above notes it will be seen that allusion is made to the same attack occurring in Wheat, which is of serviceable interest to note, as though Wheat is not as liable to this kind of Eelworm infestation as Oats, still it can be affected by it; and in the following notes, with which I was favoured by Mr. Clare Sewell Read, from Honingham Thorpe, near Norwich, he also draws attention to failure of his Wheat being in all probability from this cause; but, though this is very likely, as I did not see the specimens at the time, I cannot speak with certainty.

The notes are of much interest in showing how, when Eelworm attack is once established, its appearance may keep on recurring over a long series of years whenever crops subject to it are put in.

The first note with which Mr. Clare Sewell Read favoured me was on June 20th, as follows :—

"You may possibly remember examining for me some samples of Cow-grass Clover, which you said were damaged by Eelworms. That was two or three years ago, and now on the same field the Oats are seriously damaged, and I am wondering whether it is done by the same insect. I enclose you a few specimens, and shall be greatly obliged by you telling me what is the matter, for the Oats are half spoiled; some stems being four feet high with a bold ear, and the next plant injured as you see by the enclosed."

The specimens showed presence of "Tulip-root" disease very plainly. Some of the plants had very marked growths of the pale stunted or curved-back shoots at the more or less swollen base of the stem, and some of the upright shoots were also distorted. Eelworms were present in small numbers in the dead inside of some of the swelled bases of stems; but where the swelled portion was still alive, they were to be found in great numbers.

On June 27th Mr. C. S. Read wrote me further, enclosing some more specimens of diseased Oat plants, which proved to be excellent examples of "Tulip-rooted" and "Segged" Oats, and also enclosed an ear of the uninjured Oats, to show the great difference in condition. He also observed :—

"I may state that I believe one-fourth of the plants are totally destroyed, and are withered away; one-fourth are like those I send; one-fourth are partially injured, and the rest have escaped entirely: so that instead of a full crop of ten quarters which I ought to grow of Black Oats, I shall not harvest more than four or five quarters. I ought to have consulted you months ago, but all our Oats are so ragged and thin, that I did not think anything serious was the matter; and we say of Oats that they have 'as many lives as a cat.'"

On August 7th Mr. Read wrote me that since he had become acquainted with Eelworm attack, he had discovered their ravages

upon Oats in different parts of the county (Norfolk), and had seen some fields more severely injured than his own. Mr. Read further observed:—

"It may interest you to know the history of the field from which I sent you the diseased Oats. When I came here thirty-one years ago, I was told that it never would grow *Clover*. The land had never been ploughed more than five or six inches deep, so I thought it wanted fresh soil, so I had a steam plough, which turned a ten- or twelve-inch furrow. I drilled Wheat, and afterwards applied a heavy dressing of farmyard manure on the top, horse-hoed the Wheat in the spring, and drilled clean Red Clover. I had a good crop of Wheat, and a splendid plant of Clover, but it began to go off in the spring, and by the autumn it was all gone. I did not try it with Clover again until two or three years ago, when I sowed *Cow-grass* Clover.* You may remember that I sent you a few specimens of the failing plants, which you reported were injured by Eelworms. No great damage was done the first year, but in the second the Clover all went off. The field was drilled with Wheat in the autumn of 1894, and was a fair plant, but it went off during the winter, and I drilled most of the field over with Oats in the spring. Some damage was done to the Oats last year" [1895, Ed.], "but to no great extent; and the field was again sowed with Oats this spring. They are a wretched crop, save on those portions of the field where there was so good a plant of *Wheat* in the previous year that no Oats were necessary. No doubt these pests multiplied in the Oats; but do you not think they were responsible for the failure of the *Wheat*, as I never lost a plant before on this farm?"—(C. S. R.)

There is no doubt that the infestation may be conveyed from Oats to Wheat, or the reverse; but in this country up to the present time Clover and Oats have been the field crops most observed to be infested, Rye, which is greatly infested on the Continent of Europe, has never been reported to me here as injured by the Eelworm attack. Barley has been found, even on special experiment, *not* to take the infestation.

The following notes referring to a bad attack of the same disease, namely, "Tulip-root" and "Segging," on a large area of Oats, were sent me respectively on July 2nd and 11th by Mr. Thos. Usher, of Courthill, Hawick, N.B. At the first date Mr. Usher forwarded me a sample of diseased Oat plants, with the observation:—

"I think the Oats are affected with what is known as 'Tulip-root.' . . . I have never had it on this farm before, but this season have about sixty acres very bad with it. The Oats seemed perfectly healthy until the middle of June, and had a fine dark green colour; a large part, however, have never shot, but remained like Grass

* *Trifolium pratense perenne.*

plants. . . . The fields most affected are those sown late in the season, after the Turnip crop. The deficiency on my own fields will be at least two quarters per acre, and there are many a hundred acres round about as bad or worse."

On July 11th Mr. Usher wrote further:—

"I have no doubt from your letter that the disease in the Oats is caused by the Eelworm, as a few weeks ago the characteristics you mention were much more distinct than now; the roots had considerable sized bulbs, and a lot of short crinkled growths round them. I would be very glad indeed if you can suggest any remedy, as I am afraid when these fields are in Oats again two years hence there may be a return of the disease. Perhaps it might be as well to sow them with Barley, though that is very unusual here after Grass. I have an impression the worm does not attack Barley."—(T. U.)

Mr. Usher is quite correct in his view that these Eelworms do not attack Barley; and his observations given above that the Oats "had a fine dark green colour," but a large part remained like Grass plants, are well worth notice. I am not aware of there being precise published record of the different tints of "Segged Oats," though I have seen specimens of a deep green; but in the case of Eelworm-infested Rye, though some plants may become yellow and die, some may have a bluish green colour, and for a while look healthy, until some of the abnormal forms of the leafage being shortened, thickened, widened, waved at the edges, &c., make their appearance; and also, both in Rye and Wheat, some to general inspection may be small and grass-like.

The above observations of the past year give a very good general idea of the yearly developments of Stem Eelworm disease. First, the early manifestations in deformed and decaying Clover-shoots; later on, the base-of-stem and leafage attacks of Oats; and attacks to both crops recurring where mischief had previously taken place; also some amount of estimate of loss per quarter; and likewise report of the widespread nature of the mischief.

Prevention and Remedies.—In the case of this attack, the dressings which have been found most useful are various sulphates, as sulphate of potash by itself, or mixed with sulphate of ammonia and phosphates; or, again, sulphate of iron has been found very serviceable with "Stem-sick" Clover.

Amongst the notes sent me at different times by reliable agriculturists, sulphate of potash at the rate of one cwt. per acre has been reported as stopping disease in "Tulip-rooted" Oats, and a good crop following.

A mixture of phosphates, ammonia, and potash (proportions not given) at the rate of three cwt. per acre at sowing time on land from

which specimens of "Stem-sick" Clover had been sent me in the previous year brought an excellent growth, excepting on one sandy knoll.

In a series of experiments, steamed bone-flour, three cwt. per acre, did not succeed; there were "a number of unhealthy plants." Sulphate of potash, three cwt. per acre, answered excellently; "not an unhealthy plant on the whole plot." Mixture of about two parts of sulphate of potash, three parts sulphate of ammonia, and four parts of phosphates, also was very good; "plants healthy, with exceptions, gives promise of being the largest crop of any of the plots." Sulphate of ammonia, one and a half per cent., had a number of unhealthy plants, but was taking on a healthy growth at the time of report. The worst of all was a plot that was left unmanured, which had a yellow sickly appearance, and "a great number of unhealthy plants."—(J. E.)

Another recipe found to answer well for attack in "Tulip rooted" Oats or "Stem-sick" Clover is the following mixture: sulphate of ammonia, four parts; sulphate of potash, one part; and steamed bones, two parts; this at the rate of one and a half cwt. per acre, followed up by a dressing of two cwt. per acre of sulphate of ammonia. The result gave so luxuriant a growth that in little more than a fortnight after the second dressing, the unhealthy plants, if any remained, ceased to be noticeable.

In 1889 I was favoured by Mr. John Willis, of Harpenden, with notes of most satisfactorily successful experiment on an Eelworm-infested Clover field at Rothamsted, of which I gave the details in my 'Thirteenth Annual Report,' pp. 10 and 11, and of which the results may be given just shortly as follows:—A mixture of sulphate of potash three cwt. and sulphate of ammonia one cwt. per acre was applied on April 3rd. The disease ceased, and the Clover made a very vigorous growth, which was continued markedly in the second crop. Sulphate of iron at the rate of two cwt. also answered very well, both in stopping the disease and giving good growth; but the growth of the second crop was not quite so luxuriant as with the other application: and the sulphate of iron at the rate of one cwt. per acre was not so serviceable in stopping spread of the Eelworm infestation.

All measures, whether of treatment of the ground, or of liberal and rich manuring, of a nature calculated to drive on a hearty and healthy growth are serviceable in supporting infested plants, if of material suited for its peculiar nature. But nitrate of soda, though so valuable in many cases as a remedy, has proved, so far as reports sent to myself go, nearly or wholly valueless as an antidote to Eelworm-sickness; and for reasons given below, farmyard manure is sometimes a means of spreading the infestation by the Eelworms which may be contained in infested straw in it.

Amongst measures of prevention, one that is very important is

such rotation as will not give a crop liable to be attacked in immediate succession to one which is known to have been infested by Eelworms. Oats and Clover are the crops that suffer most severely with us; but Wheat and likewise Beans are liable to attack, and also Onions.

When a field, as of Oats for instance, is infested, it is very difficult to clear the land, and also to prevent the attack being carried about in manure, as a portion of the Eelworms, very possibly most of them, customarily leave the dying and drying plants and go into the land, and some are carried within the cut crop, and being mixed up in the straw with farmyard manure, are presently carried out again, and spread quite uninjured on clean fields, or perhaps on the very field from which they came.

To clear the land, very deep ploughing is needed, or rather ploughing with a skim-coulter attached, so that the Eelworms may be well turned down and covered over with a depth of soil through which they cannot force their exceedingly minute bodies. In garden ground, or for treatment of patches which often make centres of infestation in fields, "trenching" acts well,—that is, digging to two spades depth, and burying the upper layer wholly beneath what was the lower one of *un*infested soil. But common digging, or double digging, and also common ploughing, which only break up and scatter the soil, and do not bury the surface soil down with the contained Eelworms, do little good.

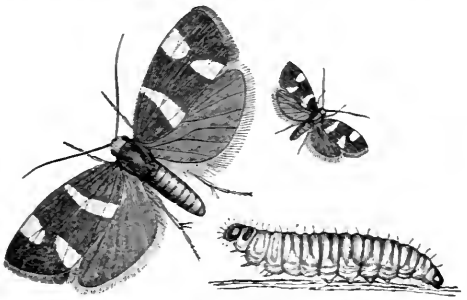
It should also be borne in mind that the Eelworms can be conveyed in infested earth. They are thus conveyed on wheels of carts, in earth clinging to farm implements and to garden tools, and even on the boots of farm labourers, and from their power of propagation a small beginning makes much trouble.

An enormous amount has been written on Anguillulidæ on the Continent, chief amongst which, for most serviceable instruction, as well as the highest scientific information regarding attacks to various kinds of plants and field crops, is the work by Dr. J. Ritzema Bos, Director of the Phyto-Pathological Laboratory at Amsterdam, mentioned below *; also in many of my Annual Reports I have given the results of careful observation by qualified agriculturists of treatment found to answer in this country, to which I refer my readers for fuller details than can be given conveniently in one Report.

* 'L'Anguillule de la Tige (*Tylenchus devastatrix*, Kuhn),' par Dr. J. Ritzema Bos, Prof. à l'Ins. Ag. de l'État à Wageningen, part i. 1888, ii. 1889; and 'Annotations,' 1891, 4to, Haarlem.

CURRANTS.

Currant Shoot and Fruit Moth. *Incurvaria capitella*, Fab.



INCURVARIA CAPITELLA.—Moths, magnified and nat. size, from life; caterpillar, magnified, after Stainton.

The *Incurvaria capitella*, figured above, has been known for a good many years as mischievous to Currants by means of its caterpillars feeding in the buds and also in the pith of young shoots of Red Currant. In 1892, thanks to the careful observations of Dr. Chapman, of Hereford,* we learnt the further points of life-history, that the moth laid her eggs on the Currant fruit, and that the young larvæ hatched from these eggs fed for a while within the Currants (thus adding another item to the regular yearly course of mischief); but it was not until the past season, so far at least as I am aware, that we had knowledge of this infestation attacking the Black as well as the Red Currant. The specimens previously sent to myself have been from Red Currant (*Ribes rubrum*), and in the various entomological records to which I have access no mention is made of the Black Currant (*Ribes nigrum*) as attacked, the notes either referring to Currants without specification of kind, or distinctly to Red Currants.

Under these circumstances, the appearance of this pest to a very injurious amount on the Black Currants at the Toddington Orchard Grounds, Winchcombe, Glos., in April last, is of interest to record. On April 10th Mr. C. D. Wise, the superintendent of the grounds, wrote me from Toddington of the pest being present in the Black Currants, and added:—"Is not this unusual? We always have an

* See paper by Dr. Chapman entitled "*Lampronia capitella*," in 'Entomologist's Monthly Magazine' for Dec. 1892, pp. 297–300. In this paper, for various reasons there given, Dr. Chapman notes that he thinks it would be desirable to change the generic name of *Incurvaria* for that of *Lampronia;* but as I am not aware of the change having been made, I retain the name of *Incurvaria* as above.

attack among the Red Currants, but I have not noticed it among Black before."

On the 13th Mr. Wise added:—

"I will send you some of the *Incurvaria capitella* which we are finding on our Black Currants. You will see what an enormous amount of damage they are doing us, as each bud contains a Currant blossom which is well formed, but which would not come to perfection."

On April 27th Mr. Wise forwarded me specimens, and I found the Black Currant shoots very much injured, in some instances the boring of the little grubs went down to the old wood of the shoots, and in others I found the grub (or caterpillar) dead within; but two of these larvæ were still alive, one within a shoot, and the other straying about, and both, as customary with this grub for most of its lifetime, of a reddish colour.

The first noticeable sign (in the spring of the year) of the presence of this attack, is the fading of the young shoots from the injuries caused by the gnawings of the little caterpillars within. In 1891 Mr. Wise wrote me:—"About April 20th we noticed numbers of the young shoots of the Red Currant bushes had withered up and drooped. On examination we found in each a small grub, which had bored its way up the stem." In 1892 Mr. Wise found the attack in the shoots of the Red Currant eleven days earlier, that is, on April 9th, when the shoots were still very small; and in the past season (1896) the attack was first reported on the 10th of the same month.

The caterpillars are red; with three pairs of claw-feet, four pairs of sucker-feet, and one pair at the end of the tail; the head red, and the segment next to it with darker marks along the hinder edges. It is stated (see Stainton's 'Tineina') to be greenish white when full fed; but in this state I have not myself seen it. The life-history (as we know it now from Dr. Chapman's observations, joined to our previously incomplete knowledge) is that in the spring the partly-grown caterpillar comes out from the small white cocoon amongst the scales and rubbish at the base of the fruit spurs and buds of the Currant, in which it has passed the winter, and boring into the buds and the young shoots, in which it feeds on the pith, injures the shoots so that they fade away and die.

These caterpillars turn into chrysalids, from which the moth appears at the end of May, and then, as discovered by Dr. Chapman, sit upon the Currant fruit, and by the aid of a "strong and powerful instrument," penetrates the skin of the Currant fruit, and lays its eggs within. The larvæ feed, as recorded, one on the inside of one seed; and towards the end of June, when most of the currants were still green, some which were prematurely showing the appearance of ripening were found to contain the little *capitella* grubs,—sometimes

only one, sometimes two. These make their way out, and spin their cocoons, as above mentioned, on the bushes, in which they pass the winter, and out of which they come in spring to complete their growth, and do exceeding mischief to the bushes.

The little moths, figured at p. 53, are only five-eighths of an inch across in spread of the fore wings, which are dark brownish or fuscous, sometimes with a purplish satiny gloss, a pale yellow band across the wing, and two patches, also pale yellow, about half-way between the yellow band and the tip of the wing; these patches respectively on the fore and hinder edges of the wing. The hinder wings are grey.

Prevention and Remedies.—Relatively to the infestation at Toddington in 1891, Mr. Wise remarked:—"The remedy we adopted for this pest was to pick off the infested shoots and burn them, which of course means a lot of labour; but what else were we to do?" A somewhat similar plan has also been found to answer well in checking mischief from attack of the little "Red Bud Caterpillar" of the Raspberry shoots and fruit, the *Lampronia rubiella*, Bjerk, which feeds very similarly, by the small caterpillars coming out in spring and attacking the young buds and shoots, the attacks being similarly made observable by the fading of the young injured shoots which have survived attack whilst still in bud condition. Of this Mr. John Speir, of Newton Farm, Newton, Glasgow, N.B., favoured me with the following note on May 25th :—

"Since 1892 I have managed successfully to keep the *Lampronia rubiella* in complete subjection by cutting out all infested canes (in whole or part) at the time the caterpillars are in the bud, and at once burning them. Poultry I also find keep them considerably in check."—(J. S.)

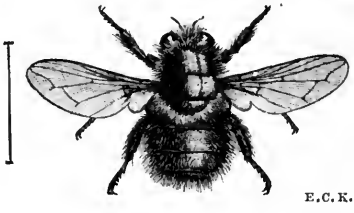
When the Currant attack has become observably established, great care should be taken in clearing the shoots, lest the caterpillars should creep away; and (obviously) the earlier in the infestation that attention can be devoted to it, the better.

Something might also be done by clearing the prematurely ripening currants, in which the summer brood of caterpillars feed in their earliest condition; and as these have been found to spin their little white cocoons for hybernation especially amongst the dead scales to be found at the bases of buds and fruit spurs, something might be done by reducing the amount of harbourage. As the caterpillar is hardly one line long when it spins its white cocoon, little could be done individually with these; but still examination with a common hand-magnifier of just a few bushes would show whether many of the white cocoons were present, and proper trimming or dressing of the cut-back masses of old spurs or bases of stems during the winter

would get rid of much presence of infestation. For dressings, any of the many forms of soft-soap applications mixed with sulphur, or some insect deterrent that would not hurt the young growths (if any of it remained to the time of pushing of the young buds and shoots), would probably answer well.

DEER.

Red-bearded Bot Fly. *Cephenomyia rufibarbis*, Meig., Brauer, and Schiner; *C. auribarbis*, Macquart.



E.C.K.

CEPHENOMYIA RUFIBARBIS, rather larger than life; line showing natural length.

In the year 1895 Mr. Percy H. Grimshaw, F.E.S., gave a most interesting description in the 'Annals of Scottish Natural History' of the Red-bearded Bot Fly, *Cephenomyia rufibarbis*, a species parasitic in larval state in the nostrils and throat and mouth parts of the Red Deer, and previously unknown in Britain, of which he mentioned that two had been presented to him, captured in the preceding summer by his friend Mr. L. W. Hinxman, in Strath Carron, close to the loch of that name, and only a few feet above high-water mark.

On March 4th (1896) Mr. Grimshaw exhibited specimens of this same species at the meeting of the Entomological Society in London, with the information that they were collected by Mr. L. W. Hinxman in Ross-shire in June and July, 1894, and in the Cairngorm Mountains in 1895; and on June 8th I received a fine recently captured specimen of this fly amongst some other Diptera sent me by Mr. Dugald Campbell, from Strathconan Forest, Muir of Ord, Ross-shire.

These successive captures are of some interest to note, as the arm of the sea known as "Loch Carron" lies on the west of Ross-shire, and the Cairngorm Mountain in the county of Banff, towards the easterly part of Scotland, and estimating these localities roughly at about one hundred and sixty miles distance, this shows a much wider geographical area of presence of this newly-recorded Deer pest than

is at all desirable, considering that its maggot life is passed in the nostrils, mouth, or throat of the Red Deer.

As yet, so far as I am aware, we have no record of its method of larval life in this country. This will be found given in excellent detail in Dr. Brauer's 'Œstriden'; and for practical purposes, as well as scientific detail in very readable form, Mr. Grimshaw's paper, which he mentions he has compiled mainly from Dr. Brauer's and Dr. Schiner's works, will be found very useful,* and with Mr. Grimshaw's permission I drew attention to it in my Nineteenth Report, p. 139.

Now, however, as the presence of the infestation appears to be extending, and I have myself seen the fly, I give a few notes, with due acknowledgment appended, of what we only know as yet from continental observation.

On June 8th in the past year (1896) Mr. Dugald Campbell, writing from Strathconan Forest, Muir of Ord, Ross-shire, N.B., with various specimens of two-winged flies forwarded accompanying, noted that amongst them were some resembling "Humble Bees," of which he asked the name. One of these (figured somewhat larger than life at p. 56) proved to be a specimen of *C. rufibarbis*, the Red-bearded Bot Fly of the Red Deer; but happily the species appears to be still very rare in the district, as, later in the season, Mr. Campbell wrote me that he had only seen one other specimen, which he nearly captured, but "it was too clever for him." This agrees with Dr. Schiner's description of the habits of this genus, of which he notes that, even where seen in great numbers, they "are difficult to take, because they seldom settle."

This Red-bearded Bot Fly is large and handsome, so clothed with hair as almost to appear furry; broad and rotund in shape, and nearly three-quarters of an inch long; the head and thorax slightly narrower than the abdomen, which in the specimen before me is nearly three-eighths of an inch in breadth. The colour chiefly black or brown, with various markings, and also interminglings of reddish, olive brown, and white hairs. The head chiefly black, but with tawny hair behind, and the forehead and part between the eyes variously patterned with black, red, and whitish hairs. Antennæ (horns) and antennal bristle reddish. The cheeks and mouth parts thickly and noticeably clothed with red hair, so as to give the appearance of a red beard running round the under part of the face, from which the fly takes its English

* 'Monographie der Œstriden,' von Friedrich Brauer, Wien, pp. 193–196. 'Fauna Austriaca: die Fliegen (Diptera),' von J. Rudolph Schiner, Wien, theil i. pp. 394, 395. "On the Occurrence in Ross-shire of *Cephenomyia rufibarbis*, a new British Bot Fly parasitic on the Red Deer," by Percy H. Grimshaw, F.E.S., pp. 155–158 of 'Annals of Scottish Natural History,' No. 15, July, 1895, Edinburgh.

name. The thorax (body between the wings) chiefly black, but with a cross-band in front immediately behind the head and in front of the wings of tawny or olive brown above, lighter at the sides, and ending in a patch of very pale hairs beneath the insertion of the wings; the hinder part of the thorax with black hairs, and "the scutellum black brown, with olive brown, and at the sides fox-red or greyish yellow, hairs intermixed." In my own specimen the edging of hair is greyish yellow. Abdomen with the fore part with blackish yellow, fox-red, or gold brown hairs; the third and fourth rings with black hair, lighter towards the tail; at the extremity and beneath the abdomen also with two white patches at the base. The bluntly rounded or bluntly egg-shaped form of the abdomen is very noticeable. The legs are black; the tarsi (shanks) brown; the wings broad, blunt, about half an inch long, and moderately transparent, with blackish brown veins sometimes bordered with a brown tinge, or the lower part of the wing with a brown tinge.

From collation of different descriptions of the fly, there would appear to be some amount of difference in colour, and in my own examination I find great difficulty in determining colour, from the great amount of variously-coloured hairs sprinkled amongst the black, or, again, of coloured and white together, and not only this, but the coloured hairs themselves not being of the same tint throughout their length, so that careful examination, with the light falling in different directions, is necessary to make out the precise colour. My own specimen runs to rather more foxy red on the centre of the upper fore part of the abdomen, and also at the extremity, like the variety described by Macquart as *auribarbis*. But in all cases this species (the *Red*-bearded Bot Fly) is distinguishable by the well-marked red band below the face from the three other species known on the Continent of Europe, in which the so-called beard is *yellow* or *grey*.*

The above notes are merely given as some degree of help towards recognising this fly by observers who would desire an untechnical description. With regard to the maggot stage, in which they cannot fail to be prejudicial to the Deer, I am not aware that we have as yet any notes of observation in this country, so I borrow the following condensed abstract almost entirely from the elaborate paper of Dr. Brauer, previously quoted.

The method of attack is for the flies to lay their small living maggots, in the early or middle part of the summer, at the opening of the nostrils of the Red Deer, up which they work, adhering by their mouth-hooks, until they reach the throat of the Deer, where they may still be found in February.

The length of the maggot at this third stage is from about an inch

* See Brauer's 'Œstriden,' p. 193.

to an inch and three-fifths, the breadth at the widest part from about one-fifth to one-fourth of an inch. The shape somewhat cylindrical, blunt at the mouth end, narrowing more gradually to the tail, at the extremity of which is a group of prickly warts. The body is beset for about three-quarters of its length from the head end with transverse bands, and narrow and shorter stripes of reddish brown prickles, the group at the end of the tail being of a darker colour. The mouth-hooks are blackish brown. The general colour of the larva is of a beautiful yellow ("schön gelb"), slightly sprinkled with delicate brown.

The exit of the maggots takes place from early in March until April through the nose or mouth of their hosts. When fallen to the ground, they endeavour at once to find some dark place for their change to chrysalis state, and if no favourable locality, as under leaves, &c., is at hand, they will creep away quickly to some distance. Here they very soon change to chrysalis or pupal state. The yellow colour gradually altering to red grey, then brown, and at last to a shining black brown, with lighter prickles.

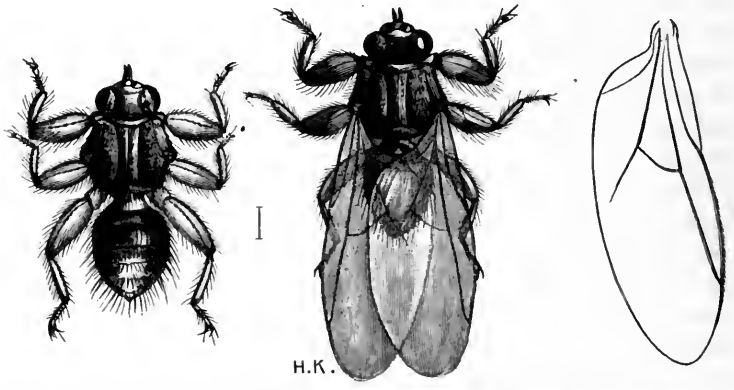
The length of the pupa is about three-quarters of an inch, the breadth at the centre about a third. They remain in this state for about three to four weeks or more, and are mostly to be found about the end of March and beginning of April. The first appearance of the flies is in May, and continues till July. (The above dates are those of the German observations.)

The effect of the attack is certainly prejudicial, for, besides other inconveniences, it is noted that, if a Deer is attacked by many flies, soon, one after the other, its nose bleeds, and the mucous skin becomes very much inflamed. When the larval growth is nearly complete,—that is, at the third stage,—the maggots are to be found in the cavity of the mouth, or at the palate, the Eustachian tube, and other localities, as parts of the tongue and gullet.

Whether there is reason to fear that this detrimental attack is really new in this country, or whether, as may be hoped, the observation of it is owing to the much increased attention given to entomological research, remains to be seen; but, meanwhile, if any plan by rewards or otherwise could be imagined by those cognizant with possibilities for its complete extirpation as soon as possible, it would be a public benefit.

With the wild Red Deer the remedies for Sheep Nostril Fly are not applicable; but though I have not sufficient knowledge of the subject to suggest with any confidence, it occurs whether by placing salt in the haunts of the Deer, which (as in prevention of Sheep Fly) the animals could only get at by rubbing their nostrils through holes smeared with tar, some preventive good might be done.

Deer Forest Fly. *Lipoptena cervi*, Nitzsch; *Lipoptera cervi*, Von Siebold and Loew.*



Lipoptera cervi, with wings thrown off; also still retaining wings; and wing: all much magnified. Line shows natural length.

During the summer of 1895 much attention was directed to *Hippobosca equina*, our long known Forest Fly, the special pest of Horses and cattle in the New Forest, Hampshire, relatively to that locality being selected as the scene of the autumn military manœuvres, and information as to the habits and measures of prevention of attack of the pest being therefore needed to save possible trouble with the cavalry Horses.

With this need, temporary attention was aroused, and then passed away; but we gained, meanwhile, a good deal of information regarding the habits of the fly, and localities; likewise regarding some peculiarities of the structure of the foot not previously observed †; and also methods of prevention of attack found serviceable in the Forest district.

But, further, consequently on this investigation, the attention of Mr. Dugald Campbell (Strathconan Forest, Muir of Ord, Ross-shire, N.B.), to whom I have been previously much indebted for observations of Deer Fly infestations, was more particularly directed to the attack of another kind of Forest Fly prevalent in that part of Scotland, and troublesome to the Red and Roe Deer.

This fly is also one of the family of the Hippoboscidæ, but differs from the genus *Hippobosca* in various ways, and especially (so far as is known, or at least generally supposed, at present) in the females

* For list of synonyms, and of slight alteration of letters in the generic name, with reasons of preference of *Lipoptera* rather than *Lipoptena*, see pp. 61, 62.

† See plates and descriptions in my Nineteenth Annual Report.—Ed.

being wingless; also in the males having the power of dropping their wings when they settle on what they consider may be a permanent resting-place or "host" animal. In the wingless condition this *L. cervi* greatly resembles the wingless "Sheep Spider," or "Louse Fly," popularly, though wrongly, known as the "Sheep Tick," and scientifically as *Melophagus ovinus*.

So far as I am aware, this Deer Forest Fly attack has not yet been brought forward from British observations, although on the Continent it has been much written on from the date of the early observations of Nitzsch in 1818, and has been variously named by various entomological observers, according to some peculiarity of which each observer took especial notice, or the kind of host animal on which he studied it. Amongst these synonyms are *Pediculus cervi*, or "Deer Louse Fly," of Linnæus (1761); *Ornithobia pallida* and *Melophagus cervi* of Meigen; *Hæmobora pallipes* of Curtis; and likewise *Alcephagus pallidus* of Gimmerthal (the generic name in this case being given from the prevalence of this fly observed by Herr Gimmerthal on Elks, *Alces;* and in localities much frequented by Elks in Courland).

In addition to distinct synonymic difference in name, is a curious variety in spelling of Nitzsch's original name of the genus, which is to be found in Cuvier's 'Règne Animal,' tome v. edited or published by Latreille, p. 544, as *Lipotepna* and *Lipotena;* and in Macquart's 'Histoire Naturelle des Insectes,' tome ii. p. 644, as *Leptotena*.

To these variations the following observations by Prof. von Siebold,* in his paper referred to below, suggest an explanation; and also some points well worth consideration in the light of correctly descriptive nomenclature, which I take leave to add on better authority than my own.

Taking first Prof. von Siebold's observation, he remarks:—"The name first adopted by Nitzsch (in Germar and Zincken's 'Entomological Magazine,' Band iii. p. 310) of *Lipoptena* has had the fate of being repeatedly erroneously understood; probably this was at first occasioned by a typographical error, and instead of *Lipoptena*, it should really be *Lipoptera* (λιποπτερα), 'wingless.'"

In the work above quoted (volume for 1849, p. 294) is also a paper by Dr. Schaum on *Ornithobia pallida*, Meigen, and *Lipoptera cervi*, Nitzsch, with a note appended on the above point—that the writer has here re-established the name as without doubt Nitzsch desired to give it; and he adds that "von Siebold's conjecture that *Lipoptena* can only be a typographical error in lieu of *Lipoptera* is apposite and convincing." At p. 296, amongst various observations made by Prof. Loew at Dr. Schaum's request on similarity of *Ornithobia pallida*

* See 'Ent. Zeit. von Ent. Ver. zu Stettin,' volume for 1845, pp. 275–279.

and *Lipoptera cervi*, Prof. Loew (who makes use of the revised spelling, namely, *Lipoptera*, in his paper) observes:—"The name *Lipoptera cervi* is the most suitable, and at the same time the only one to which the insect under consideration is entitled."

In the same series (*i. e.* 'Ent. Zeit. zu Stettin,' 1850, p. 407) are some further observations * of the synonymy under the heading "Still a word on the *Lipoptera cervi*," in which Prof. von Siebold writes as follows:—"Through the interesting remarks of Herren Schaum and Loew, again carefully brought forward on *Ornithobia pallida* in this publication, I have now convinced myself that it really is no other than a winged *Lipoptera cervi*, Nitzsch. But I must go still further, and maintain that the *Hæmobora pallipes* of Curtis is also only a winged *Lipoptera cervi*." †—(C. Th. von Siebold.)

Not being myself a Greek scholar, I do not give the subject *in extenso;* but it is before all of us that the word "*ptera*" is constantly used entomologically to signify wings, especially in the names of the insect orders, as, for instance, in the words Lepidoptera = scale-winged, Thysanoptera = fringe-winged, and so on. And in this case there is a most obvious propriety in the word "*Lipoptera*," that which looses wings, being used to express the unusual habit of the males of this insect dropping or removing their wings. On the other hand, if we have instead of this descriptive word, with an "r" as its penultimate letter, the word "*Lipoptena*," with an "n" as its penultimate letter, we thus get a word which, in its meaning (*not* of wingless) but "hairless," or "childless," is entirely inappropriate to this insect, which assuredly cannot be said to be without progeny, nor to anyone who will examine the almost bristly besetting of its hind legs, and to some degree of the abdomen, will it appear hairless ‡; and for this reason, as the word has been used by so many German writers, I have thought I might be justified in again using it.

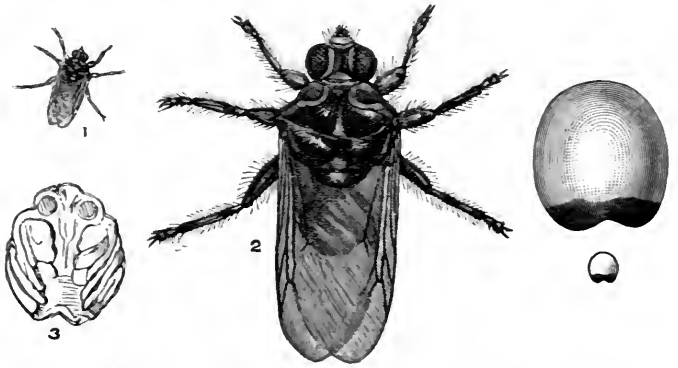
This *Lipoptera cervi* (von Siebold, &c.) is (like our common Forest Fly of the New Forest) one of the *Pupipara*, that is, it multiplies by

* "Noch ein Wort über *Lipoptera cervi*," von Prof. C. Th. von Siebold, in Breslau.

† For figure in a fairly accessible work of *L. cervi* under this synonym, see plate xx. fig. 4 in vol. ii. of 'Ins. Brit. (Diptera),' by F. Walker. This figure is by Prof. Westwood after Curtis, the fly being about four times magnified; and if the neuration of the wings is considered simply as the long vein near the fore edge, a shorter longitudinal vein nearer the hinder edge, and a transverse vein joining the two, without reference to the minor slight indications, it gives an excellent idea of the wings of the *L. cervi* before me under a one-inch object-glass, as figured from life, much magnified, at p. 60.

‡ As the above points seem to me to be of great interest, I have ventured to draw attention to them on the authority of the entomologists referred to, with submission to some friends conversant with the Greek derivations.

laying *not* an egg, or anything looking like a maggot or larva, but a *puparium*, or chrysalis-case, in which the insect matures, and from which it presently comes out as a perfect fly. It is very like our common Forest Fly, *H. equina*, in general appearance,—that is, it is flat in shape, and horny in texture, and with the two wings (when these are present) laid flat on the back, slightly overlapping each other at the inner edges, and projecting much beyond the tip of the tail,—but is a good deal smaller. The Forest Fly is about a quarter of an inch in length, whilst the Deer Forest Fly is only about one-sixth of an inch in length from head to tail. My largest specimens are slightly longer, and from front of head to tip of wings, when laid at rest, they measure just four lines. The two kinds may be clearly distinguished by the veining of the wings (see figures, p. 60 and below).



HIPPOBOSCA EQUINA.—1 and 2, nat. size and magnified from life; 3, pupa removed from puparium (after Réaumur). Puparium nat. size and magnified, before complete colouration.

The above figure of our common Forest Fly, especially troublesome to Horses in the New Forest, is added to give opportunity of comparison with *L. cervi*, especially in the neuration of the wings.

The general colouring of *L. cervi* is of a horny brown or yellow; the head shiny yellowish, with the top of the head and the pits of the horns (antennæ) black brown; mouth parts brown. Thorax flat, chiefly brown, and with small bristly warts. Abdomen yellowish or brown, covered with very minute warts bearing bristles, and somewhat variable in shape; small in the males, and with the rings bristly at the hinder edges, somewhat cylindrical, or inclining to be conical (at the base almost pedunculated); larger at the extremity in the females, and more of the shape of Olfersia. Legs chiefly yellow; the thighs short and thick, it is very noticeably the case with the foremost pair; legs hairy, especially the hinder pair, which are greatly beset with thick bristly hairs. Claws black, long, curved and horny, each with a somewhat thumb-shaped much shorter claw at its base, and the

curved claws having transverse furrows on the side, and saw edges, as in the case of *H. equina*. The *empodium* and other membranous structures in the middle of the foot, as the long bristle-like process, very much developed. The neuration of the wings in the specimens sent, as seen by a one-inch object-glass, is exactly as figured at p. 60, and for common purposes may be described as the first longitudinal vein being single, and the other (readily observable) longitudinal vein being distant from it, and curving outwards at the end to the hinder edge of the wing, the two being joined by one transverse vein. The wings are very pale, with yellowish veins, and project much beyond the body of the fly.*

As yet, the matter of the females of *L. cervi* being wingless from birth does not appear to be considered as absolutely established; nor have I been fortunate enough to see the operation of the males shedding their wings, nor to find a description of how it is done. In about sixteen specimens or more which I examined, which had been put alive into little packets of paper, or into envelopes, I found the greater number still had both wings entire, but of the others the absence of the wings in almost every instance was caused by one or both being very obviously broken or torn off from the piece remaining attached to the body at a little distance from it, in a manner that might have been done by the claws with their fine apparatus for holding; but as none of the wings broke across in my frequent moving of them from one paper to another, it seemed hardly likely that the cross-fracture could be accidental.

In the following pages I give in sequence the very interesting notes with which I was favoured by Mr. D. Campbell, from Strathconan Forest, Ross-shire, N.B., on the life-history and habits of this fly, accompanied later on, about the middle or end of autumn, by a good supply of specimens. On March 27th Mr. Campbell wrote as follows:—

"Besides warbles, the Red and Roe Deer are much troubled with other insects. . . . They are locally called Deer Bugs here. They are not unlike the Sheep Spider Fly, perhaps not quite so large, are flatter, and dark in colour. They are to be found in hundreds on some of the animals, and are able to run in all directions through the hair very fast. They cling with great tenacity to the skin, or hair, as the case may be, and I have no doubt live by blood-sucking; they never fasten to the skin like ticks, but bite like the Sheep Spider Fly.

* For full technical description of *L. cervi*, see 'Fauna Austriaca: die Fliegen (Diptera),' by Dr. J. R. Schiner, vol. ii. pp. 648 and 649. In my own examination, as I had not also type specimens of this species for comparison, I was greatly obliged to Mr. O. E. Janson, who was good enough to compare my specimens with those in the British Museum, and verify them as being certainly *L. cervi*.

I think these bugs drop off about this time, or perhaps later on, and are not seen again till the month of July, when they are provided with wings, and are a great annoyance to people walking through the woods, or through bracken, or other such shrubs. They fly at any moving object, but only settle upon Deer, when, after a while, they loosen their wings.

"When flaying Deer in winter they bother us very much, for they creep into one's clothes and into one's hair in wonderful quick time, and (like the description you give of the Forest Fly) they grasp with such tenacity that they will not be removed until they are caught between the finger and thumb, and it takes a lot of squeezing and twisting to kill them. If they are not already known to you, I can send you any amount of them later on."

On June 8th Mr. Campbell sent me some further observations, and amongst them he remarked:—

"By the beginning of August I have not the least doubt I can send you plenty of winged Forest Flies. They then, or a little afterwards, fly at us, and indeed bother us a great deal going through some parts of the Deer forest, such as woods and bracken, &c. These I can send, and later on can get any amount of them on the Deer, *but they are all then wingless.*"

This remark of Mr. Campbell's I have given in italics, as it corresponds exactly with that of Herr Hartmann, which I give further on (more at length), that he had found *wingless* individuals of the Deer Louse Fly (*L. cervi*), male and female, in the coat of the Red Deer the whole winter through.* Mr. Campbell remarked:—

"This is all I can do except to search the hair well for puparia when the time comes, which you may depend on my doing."—(D. C.)

In the course of the season Mr. Campbell favoured me with various observations of the Deer Forest Fly; but it was not until October 27th that he was able to furnish me with specimens, which proved to be *L. cervi*, some in winged condition, and some with the wings thrown off, or with the rings only represented by remains of the wings. Mr. D. Campbell mentioned:—

"This season, owing to the continual cold and wet, has been one of the most, if not indeed the most, difficult to find them that I can remember. They would not fly at one, as I often used to see them do. Besides this, I had no chance of going purposely to look out for them; only when walking with our sportsmen through woods I could get one now and again, and wrap it in a bit of paper, and pocket it. . . . Those I now send are all dead; all had wings when captured, some as early as August 28th, and some as late as

* 'Deutsche Ent. Zeitschrift,' xxi. 1877, Heft ii.

October 19th. . . . In the winter, when we are shooting hinds, I have no doubt I can send you some off the Deer. They will then have no wings, and are a good deal bigger."

On November 12th Mr. D. Campbell kindly sent me some more specimens of *L. cervi*, mostly in very good order, and still preserving their wings. He noted:—

"I enclose a few Deer Forest Flies alive. They are difficult to get now, but to-day being fine and mild, I was lucky enough in getting a few. I hope they will reach you alive; I have noticed they live but a short time after being captured, at all events if kept about one's person."—(D. C.)

These specimens were in excellent condition, and I greatly regretted that from great pressure of business I was not able to continue investigation of the more elaborate portions of the structure of the foot, which I commenced in 1895 with regard to that of *H. equina*, but shall hope to carry this out at a future time.

The following notes and also observations collected by Prof. J. P. E. Fred. Stein* are of much interest, both with regard to various points of life-history of this Deer Forest Fly, and also as showing much coincidence, so far as we have observations, between its habits on the Continent and as observed by Mr. Campbell, Prof. Stein observes:—

"The winged males of this species are met with from late summer until autumn in leafy forests† frequented by the Roe or the Red Deer; the females, on the contrary, with their wings shed, are to be found at the same time of year in the hairy coats of the above-named kind of Deer, and also of the Elk. The natural history of these flies still requires more explanation, which can only be acquired by observation of them on their host animals."

After some further remarks, Prof. Stein notes that on a visit to Herr Hartmann ("an assiduous dipterologist"), at Weissenbach am Attersee,‡ that he had taken many pairs of these flies alive on the Red Deer; and with his permission, Prof. Stein printed his information on this subject, which I have given verbatim as follows:—

"Herr Hartmann related:—'Wingless individuals of the "Deer Louse Fly" I found the whole winter through, sitting on one another in the coat of the Red Deer; the uppermost insect was always a male.

"'The females enclosed with their males in a glass often deposited pupæ, and after that pairing again always followed. . . . On the

* 'Deutsche Ent. Zeit.,' xxi. 1877, Heft ii.: "Der Naturgeschichte der Lausfliege, *Lipoptena cervi*, Nitzsch," von J. P. E. Fr. Stein, pp. 297, 298.

† "Laub-waldern," forests of deciduous trees, as opposed to forests of pine trees.

‡ The Atter or Kammer Lake is in Upper Austria.—Ed.

Deer single flies were seldom to be found. . . . One pupa was also found in the Deer's hair.

"'From eleven pupæ kept till the beginning of August in the next year, none developed; but afterwards, however, when these had been exposed for one day to sunshine, three males developed from them, whilst all the others remained undeveloped.

"'The developed males now resembled some of those seen in the autumn; but were observably distinguishable from those which, with nothing but rudiments of wings, were found resting on the females in the hair of the Deer. The first are pale yellow, and the abdomen is slender, and shrivels considerably after death; the latter are more yellow brown, their abdomen is wider and firmer.'"

Prof. Stein further mentioned that he had been informed by Herr Scherfling (likewise a special observer of Diptera) that in an excursion near Spandau he had found a dead Roe Deer on which numerous individuals of the above-named flies were thronging, and then creeping in amongst the hair. From these he took a good number, which on later examination proved to be specimens both of males and females; from these last, however, at the point of death, the wings were thrown off,* and on this Prof. Stein makes the observation that, "according to this, it is possible for the females to preserve their wings, consequently on killing happening immediately after capture by means of a rapidly acting poison."

Taking so much of the life-history of these *L. cervi*, or Deer Forest Flies, as we gain from the preceding observations, it appears that the males and females are to be found in wingless condition on their host animals, and notably on the Red and the Roe Deer; this to such an extent that, as observed by Mr. Campbell, they are very troublesome to those employed in flaying Deer in winter, by reason of their creeping rapidly about the clothes and into the hair of the workers, and being very difficult to dislodge. About the end of March Mr. Campbell considered they dropped from the infested Deer, and nothing more was seen of the attack till July, when they were observable in winged form, and very disagreeable to those walking in the wooded haunts they frequent; and when they settle, as on Deer, soon losing their wings.

In the German observations it is similarly noted that the winged males are found from late summer to autumn in leafy forests fre-

* As this is an important point, I give the remarks also in the original language for fear of any misapprehension on my own part. Speaking of his examination of the males and females, Prof. Stein observes:—"Von denen jedoch letztere im Todes-kampfe sämmtlich die Flügel abgeworfen hatten. Hiernach musste am vielleicht den Weibchen die Flügel zu erhalten, die Todtung unmittelbar nach dem Fange, mittelst eines sehr schnellwirkendes Giftes erfolgen."—(J. P. E. Fr. S.)

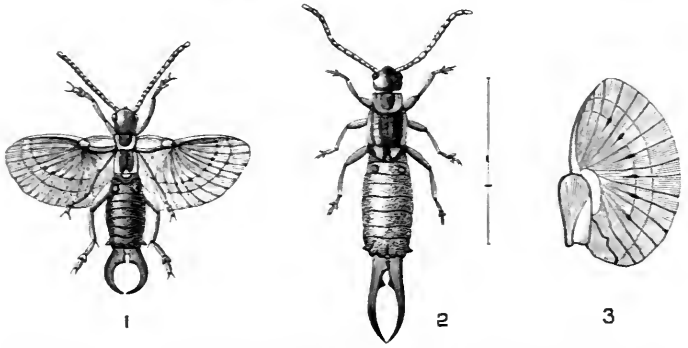
quented by the Roe and the Red Deer; but the females "with their wings shed" in the hairy coats of the Deer and the Elk. Further observations are quoted by Prof. Stein of the male and female *L. cervi* being found the whole winter through together in the coats of the Deer; and that under special observation (as under a glass where they could be watched) frequently paired, and the females deposited pupæ. Of these pupæ, eleven were kept till the beginning of August in the following year, and did not develop contents up to that date; but afterwards, when these had been exposed one day to the sun, three males developed, but no others of the pupæ developed.

We thus from the different observations (and others of which these may be taken as a sample) gain the general points of the life-history of this *L. cervi*, though there is a good deal that we still need.

As we have not (so far as I have found) any observations of the flies seriously annoying the Deer, either by blood-sucking, or (like our *H. equina*) creeping and running about the hair and skin till they drive their host animal (if unused to their presence) nearly wild with terror, it appears presumable that their presence is of no great consequence. But still there are several points which it would be of great interest to know more about; one of these is—what locality the pupæ are usually deposited in? One would conjecture it was amongst the hair of the Deer. Also it would be of great interest if we could have some more definite information as to whether the females are winged or not; and also what is the manner in which the wings of the males are removed.

EARWIGS.

Common Earwig. *Forficula auricularia*, Linn.



1, Forficula auricularia; 2, F. forcipata; 3, wing of *F. auricularia*: all magnified.

Earwigs are amongst our regular summer pests, and in some years (as in 1886) they do serious damage to field crops, in addition to their garden depredations, and also to the annoyance they cause by their intrusion into dwelling-houses after sunset, and establishing themselves in food, clothing, beds, or wherever there may be a dark and comfortable locality.

But common as the creatures are, their method of life (independently of their troublesome and mischievous habits) is not as generally known as could be wished, and is so frequently asked about, that a few notes of it may be of interest.

The past summer was an especially bad season for prevalence of Earwigs in various districts, and besides complaints of them as garden pests, they were reported during July by various correspondents as doing serious mischief to their Mangolds, young Swedes, and Turnips, and also to leafage of Hops; likewise, in one case, an infestation to Apple trees was reported, pointing much more to damage to the late Apple-blossom than to any beneficial work done as insect killers.

By July 6th Earwig presence had become so noticeable that attention was drawn to it, as well as to a method of collecting the creatures, in the article on "Agriculture" in 'The Times' newspaper of Monday of the above date, as follows:—

"Earwigs are usually troublesome in gardens rather than amongst field crops, but they have lately been doing considerable mischief upon farms in the counties of Oxford and Wilts. In the latter county they have destroyed young Swedes on an extensive scale; apparently taking

refuge in an old stack by day they have come forth in hordes at night and killed the plants by biting them through at the neck. A piece of sacking, that had by chance been left in the field, when picked up was found to harbour thousands of these pests, and this suggests a method of trapping them, though their numbers are so great that they are to be seen crossing the highways."—('The Times,' July 6th, 1896.)

In the past season Earwigs, if not more present than usual at Hop-leaves, have certainly been more observed; and on June 26th I received, per favour of the editor of the 'Agricultural Gazette,' mention from a contributor that the leaves of some of his Hop plants were very much eaten,—he believed by Earwigs,—and information was requested. On examination, it appeared that Earwigs were certainly the cause of the damage; and the following note was given by the same contributor in the 'Agricultural Gazette' for July 8th:—

"Since writing I have satisfied myself that Earwigs are the cause of the mischief. They swarm in the crevices of the poles, and in the curled Hop-leaves, and come out at night to feed. . . . Yesterday I had about three hundred flower-pots, each with a wisp of straw in it, put on sticks, and this morning each flower-pot had from five to twenty-five Earwigs in it. I propose to put up about one thousand flower-pots, and hope in that way to lessen the attack." *

Probably no plan of trapping answers more surely than providing some snug and dark resort into which the Earwigs can creep and hide themselves during the daylight hours. (For details see Prevention and Remedies.)

The following note regarding catching the pests at night by shaking them down on some tarred surface when they are out at feed is well worth notice, both with regard to Earwigs, and the small Clay-coloured Weevils (*Otiorhynchus picipes*), which do much mischief by night, and also the Cuckoo or Frog Flies (*Euacanthus interruptus*), which sometimes do great mischief by sucking away the juices, especially of the tops of the Hop-bines, by day. On July 1st Mr. A. Chittenden, writing from Posiers, Borden, near Sittingbourne, Kent, noted the mischief caused to Mangolds and Hop-leaves:—

"We are much infested with Earwigs in this part of the country; one of my fields of Mangolds has been nearly cleared by this pest. The Hop-gardens round are full of them; out of my nearly fifty acres, three have been almost cleared by them. Last night I caught about a hundred from two Hop-hills; this would be an endless task on so much ground."

* For above notes, and remedies suggested by E. A. O., see the 'Agricultural Gazette' for June 29th, p. 627; and also for July 6th, p. 8, for identification of attack.

In reply to my letter with some suggestions Mr. Chittenden wrote, on July 6th, as follows:—

"I am catching the Earwigs in tin-pots put over the Hop-hills; also I employ four men from nine in the evening to the small hours, two carrying a platform covered with tar, and two shaking the strigs and poles. I find I am getting rid of numberless Earwigs. I mean to persevere with this for the next ten days."—(A. C.)

A plan of much the same nature was used with excellent success for clearing the Cuckoo or Frog Flies, or Jumpers (*Euacanthus interruptus*), some years ago, from Hops near Alton, Hants. These flies have long hinder legs, with which they take tremendous leaps, and the plan used was to have two trays about six feet long by two feet six inches wide made of corrugated iron, turned up with a three-inch rim, and with a handle at each end. These trays were well smeared with tar (which the rim prevented from running off), and placed one on each side of the hill, and on the Hop-poles being shaken, the "Jumpers," taking their extraordinary leaps, fell into the tarred trays, and were at once thus destroyed without further trouble. Other ways, such as using strips of cloth or bagging well tarred, were tried, and in all cases answered well, and might be expected to answer as well for Earwigs.

On July 11th Mr. Edw. Gordon, of Canon Court, Wateringbury, near Maidstone, wrote me of Earwigs being present in "almost every Hop-garden" in the district; but for the most part not to a really serious extent. Mr. Gordon remarked:—

"Almost every Hop-garden in this neighbourhood shows some damage from this pest, but in no case have I seen it sufficiently severe to cause much uneasiness. In my own gardens I have found a few hills badly attacked, and have killed the Earwigs in the cracks of the poles with a knife, but this would be a tedious process on a large scale."—(E. G.)

But though destroying the creatures one by one would certainly be an expensive process, still Mr. Gordon's note of the Earwigs being in the cracks of the poles, and the note (p. 70) of the Earwigs being "swarming in the crevices of the poles," might perhaps be utilized to making these cracks and crevices undesirable to them.

The following note refers to Earwigs as destructive to field crops, especially Turnips and Swedes. On July 8th Mr. Edgecumbe Parsons, writing from Coates, Cirencester, asked for information as to the habits of Earwigs, "of which this year we have immense numbers. They are clearing off Swedes and Turnips wholesale, and even attack Potato-tops."

In the course of further communication regarding the Earwigs, Mr. E. Parsons observed:—

"I found one a short time since in charge of a number of minute young ones, which reminded one of a hen and her chicks."—(E. P.)

This careful watch of the Common Earwig over her eggs, and then over the newly-hatched young, though not, I believe, often noticed, is a long and well-established fact; and though it is rather turning her maternal instincts to an unkind account, is a habit which may be very thoroughly used for our own benefit by such thorough disturbance of surface-soil of infested land, as will scatter the cluster of eggs or the newly-hatched progeny broadcast.

The following communication from Mr. A. Burgum, of Mathews, Dymock, Glos., sent on July 17th, regards the probable occupation of the Earwigs, then numerous on his Apple trees:—

"My Apple trees are *infested* with Earwigs. I do not know whether these insects consume any of the Aphides; if they do, I should hesitate to destroy them. I am under the impression they eat the Apple-flowers. I fear they do not interfere with any caterpillar life."—(A. B.)

From published observations of food naturally preferred by Earwigs, it is at least very likely that they were feeding on vegetable matter. The precise kind could not be told without careful watch, or examination of contents.

Other reports sent only referred to ordinary kinds of depredation; but also included request for information as to the habits and life-history of these insects, so as to give a foundation for methods of dealing with them.

Life-history.—Early in the year the female Earwig lays (under stones, or in a hole in the ground, or amongst dry leaves, or the like places, but always in some concealed spot) a little collection of from fifteen to twenty yellowish eggs, by which she remains, or sits upon them, and collects them together again if scattered abroad.*

After the lapse of about a month the young Earwigs hatch; but still for a while the mother Earwig remains by her white wingless progeny, "like a hen by her chickens." The young, which soon become brown, are very like the full-grown insects in shape, excepting that for some time they have neither wings nor wing-cases; after several moults, the shape of the wings shows, and at the last moult, which is towards the end of August, the Earwig takes its perfect condition of male or female, with wings and all parts complete.

Earwigs are well known by their narrow long shape, with the tail ending in a pair of forceps (see figures, p. 69). The *Forficula auricularia*, our commonest kind, is distinguishable in the males (see fig. 1,

* For notes of personal observation of this singular habit see 'Mémoires' of De Geer, vol. iii. p. 548; also of his own observation of it by Dr. E. L. Taschenberg in his 'Praktische Insektenkunde,' pt. iv. p. 188.

p. 69) by the forceps being semicircularly curved, and with the tips meeting, and a tooth within at the base; in the female they are nearly straight. The colour is mostly of a dark red brown; the head reddish; eyes black; the shield-like portion behind the head very dark or black, with pale borders; behind this are the wing-cases (for position in repose, see fig. 2, p. 69 *). These are placed flat, are very short, and meet at a straight line running along the middle, and are of a pale red or yellowish brown colour; a small triangular pale mark projecting from beneath each wing-case shows the tip of the "tightly folded" wing beneath, from which this order takes its name of Euplexoptera, or "tightly folded wings." At figures 1 and 3, p. 69, the great size of the delicate membranous fan-shaped wing when expanded, as compared with that of its little scale-like cover, is given much magnified. The abdomen is mostly dark red or rusty black; legs very pale. The length is from about half an inch to upwards of three-quarters; and though by very far most numerous in summer and autumn, these Earwigs may be found during the whole of the year.

Their feeding-time is at night, and they shelter themselves from light by day. This may be under stones, or tiles, or bits of wood, or rough slabs or pieces of timber, or amongst withered leaves, or in badly pointed or ruinous walls. They are also to be found in great numbers in such shelter as is afforded them on their food-plants, as amongst the petals of Dahlias and Carnations, in the dried and curled leaves of Hops, or of Apple trees, or on wall fruit-trees, squeezed in between the nectarine or other fruit that they may have been ravaging and the wall, or, again, sheltering beneath fallen and half decayed fruit on the ground. It is impossible to enumerate the variety of their hiding-places out of doors, from the broadscale shelter of a haystack to the chinks in a Hop-pole; and indoors, in bad Earwig years, beds, boots, pastry, bread, anything which affords dark shelter, especially if it unites the convenience of food with it, may serve as a hiding-place.

Prevention and Remedies.—The most convenient plan for garden purposes is the long known method of trapping by putting a little bunch of hay or straw in the bottom of a moderate-sized or rather small flower-pot, and then setting the pot wrong way up on the top of a stake to which the infested plant (as a Dahlia, for instance) is fastened. If the hay is well pressed into the bottom of the pot, its

* Figure 2, p. 69, is after the figure of *F. forcipata*, by Prof. Westwood, plate xxviii. of Stephen's 'Ill. Brit. Ent. (Mandibulata),' a larger and less common kind than *F. auricularia*, but very like it in general appearance. The wing, figure 3, is from p. 151 of the truly useful volume 'Our Household Insects,' by Mr. Edw. A. Butler. (Longmans, Green & Co.)

own elasticity keeps it from falling out whilst the pot is being turned wrong way up; and each morning the hay should be examined, or shaken out over a gravel walk, or broad board, or some hard smooth surface, so that the Earwigs which fall down, and would, if allowed, run away quickly, may be killed before they can escape. The pots can be examined and the Earwigs killed very rapidly; and at the rate of from five to twenty-five Earwigs a morning (see p. 70) a very useful clearance made. Taking the average at fifteen, this from the three hundred pots mentioned would give four thousand five hundred of the pests got rid of daily, which must be a relief to the plants.

In a bad attack of Earwigs on an experimental plantation of Tobacco tried by the late Mr. Faunce de Laune, at Sharsted Court, near Sittingbourne, in 1886, the following note was sent me regarding the plans being tried to catch the Earwigs:—

"We have several plans of catching these insects. . . . The plan I have found to answer best is by hanging old bags on gates near the Tobacco, or on stakes amongst the plants; old felt hats also catch a tremendous quantity by placing them on the top of stakes, and clearing them out daily."—(A. R.)

Another plan of trapping, which is found to answer well for field service in Germany, is to leave old field weed baskets standing (presumably wrong way up) in one place for a day or two. When these are jarred smartly on the ground in the morning, even on a smooth clear piece of ground, it is stated that such numbers of Earwigs fall out, that it is difficult to trample on them all before some of them escape. In such a case, shaking them out on to a tarred board would be an effectual stop to their getting away.

Another German plan is to lay little bundles of Bean- or Cabbage-stalks, or any kind of stems which Earwigs will frequent, about the infested field or garden bed, and clear these from time to time. In 1886, which was a year very remarkable for prevalence of Earwigs, one of my correspondents sent me the following note:—

"Small heaps of straw laid at short intervals and fired in a still evening, after a few days, will destroy immense quantities of Earwigs and beetles."—(R. W.)

The plan mentioned at p. 70 with regard to clearing Hop plants of the infestation is a well proved one, and one that can be used on a large scale, and might be serviceably applied also where Earwigs are found to be damaging blossom or young leafage of Apple or other standard or espalier fruit trees.

What the reason of the occasional very great appearance of Earwigs may be in cases where, as in Mangold or Turnip fields, the ground has been thoroughly well turned and stirred, is quite unknown to me; the only thing that occurs to me as perhaps the cause, is the

infestation being carried out in manure, as heaps of manure are one of the localities frequented by Earwigs.

In gardens where Earwig attack is a regularly recurring yearly trouble, much might be done to lessen it by disturbance of neglected surface-soils, keeping walls in such order as to afford no shelter, and also clearing the various kinds of rubbish, as wood, stones, clods of hard earth, &c., beneath which they hide. Our true Earwigs, that is, Forficulæ, including *F. auricularia*, although they have ample wings, are considered only occasionally to fly, therefore it would appear that local measures of prevention would be of service.

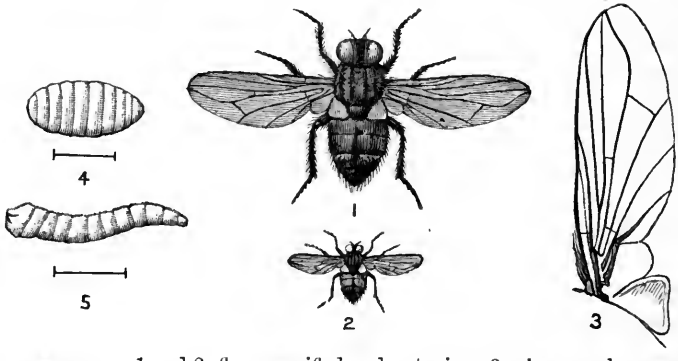
In years in which the Earwigs abound to an extent to be seriously troublesome in houses, no way to obviate this great annoyance seems yet to be before the public, excepting shutting down the windows at the time of their more especial evening date of entrance, or guarding the openings with muslin, as against wasps in vineries.

One other rare but really occurring occasional annoyance from Earwigs remains to be noticed,—this their sometimes creeping into the chamber of the ear. Although the popular idea that they can gain entrance thence into the brain is altogether erroneous and an impossibility, still anyone who has suffered (as I myself have done) from an active insect getting into the ear will know the very great annoyance that it has the power of causing so long as it remains alive. In some cases, just gently placing a dry grass-stem as a means of exit to the insect, I have found to be all that was needed,—of course, being careful not to allow the stem to touch the drum of the ear. But with Earwigs this plan would be hardly likely to answer, as these insects like freedom from light. But the annoyance may be quite stopped by having a little sweet oil dropped into the cavity of the ear, which will very soon kill the insect, and the remains should afterwards be syringed out, or extracted by a medical man, or some one competent to do so, as rough or unskilled treatment might cause very serious damage.

FLIES.

(TWO-WINGED.)

House Fly. *Musca domestica*, Linn.



Musca domestica.—1 and 2, fly, magnified and nat. size; 3, wing, much magnified; 4, chrysalis, and 5, larva, magnified, with lines showing natural length.

House Flies may fairly be noticed in connection with agricultural pests, as, independently of the annoyance they cause to our animals as well as to ourselves, one of the great quarters from which they come to trouble us is horse manure. Year by year enquiries are sent to myself as to their life-history; and for a clear and trustworthy detailed account in our own language, the only publication to which I am able to refer my applicants is the very useful volume by Mr. Edw. A. Butler on these and other household insects referred to below.* Still much has been written on them by various home and continental observers of practical as well as scientific interest; and without myself venturing to offer an opinion on the subject, it seems to me that it may be very useful to give some extracts to show that though we have proof that this species (*Musca domestica*) especially occurs from eggs developed up to fly condition in horse manure, yet that it is considered, on the authority of well-known observers, as also passing its early stages in various kinds of putrid matters, which therefore require attention.

Several other kinds of flies are very commonly to be found in our houses, including amongst these *Stomoxys calcitrans*, sometimes called the "Stinging Fly," which can give a painfully sharp prick by means of a needle-like proboscis projecting straight forward, and of which the maggots live in fresh horse-dung.

* 'Our Household Insects.' London and New York: Longmans, Green & Co. 1893.

From these the *Musca domestica* are distinguishable by having, *not* a sharp *pricker*, but "a soft proboscis adapted for suction, but incapable of penetrating the skin; so that when these insects trouble man and animals, it is only to imbibe their perspiration. They cause annoyance by their importunity, and irritate by the tickling and itching they induce by their pads and proboscis." *

In the past year, besides enquiries merely regarding methods of prevention and remedy for the visitations of these flies, I was favoured by receipt of so much interesting observation by Dr. Spooner Hart, Calcutta, relatively to annoyance caused by this *Musca domestica*, and its propagation in horse-dung, that, with Dr. Hart's notes, I have endeavoured to form some connected account of the life-history of these very great pests, together with some slight addition regarding measures I have found of service in getting rid of them.

The description of the House Fly, *Musca domestica*, is thus given shortly, but enough detailed for practical purposes, by John Curtis:—

"It is clothed with black hairs and bristles; the antennæ are black, with feathered setæ; the eyes are remote, particularly in the females, and are of a dull or brownish red; the space between them is black, but the face between them is satiny yellowish white, and a similar line surrounds the eyes; the thorax is bright grey, with four blackish longitudinal lines; the abdomen cinereous or clouded ochreous, with a blackish line down the back, and smaller elongated spots on each side, varying with the light; the belly is ochreous, base of the wings yellowish; the six legs are long, slender, and blackish. The abdomen of the males is of a transparent ochre on the sides, and the apex is rounded; but in the females it is conical, and often of a clouded ash colour." †

For the sake of forming a tolerably connected life-history of *M. domestica*, the species most particularly known as *the* House Fly, I have given the main points as recorded by John Curtis, Dr. J. Ritzema Bos, Dr. E. L. Taschenberg, and Mr. Edw. Butler; but at the same time I should note that I have only selected just enough from their detailed and valuable records to give the chief points needed, referring my readers in each case to the original writers.

It appears that this infestation may pass the winter in fly, maggot, or pupa state; and beginning with their earliest appearance, Dr. Taschenberg mentions that with the new year the flies may be seen with weakly legs struggling about on some sunny piece of wall; but with spring air, spring feeling awakens, and they become possessed of

* 'Parasites and Parasitic Diseases of Domesticated Animals,' by L. J. Neumann; translated by Geo. Fleming, C.B., LL.D., F.R.C.V.S., p. 32.

† "The House Flies," by Ruricola (John Curtis), 'Gardeners' Chronicle,' February 3rd, 1844, p. 68.

their usual activity; and eight days after pairing the females lay their eggs on various substances, as damp spoiled provisions, decayed meat or broth, slices of melon, dead animals, also in dung-pits, and places where manure is stored, &c.; and Dr. Taschenberg also mentions the maggots as being found most especially in horse and fowl-dung.*

John Curtis (in paper previously cited) writes as follows:—

"The House Fly, *Musca domestica*, like most other insects, lays eggs; . . . these are deposited in hot and moist dung-hills, and probably in putrefying vegetables, and refuse in gardens, muck-bins, and similar situations, and hatching into minute maggots of a dirty white and yellow colour, they feed until they arrive at the size of figure 2." [This, in Curtis's paper, represents a cylindrical legless maggot, about a third of an inch long, and rather more than a sixteenth in width at the thickest part, blunt at the tail extremity, and gradually tapering to the head end, as represented, much magnified, in my own figure 5, p. 76.] "When fat and full fed, they lie dormant a few hours, during which time the skin hardens, and becomes of a chestnut or rusty brown colour. . . . In this quiescent state they remain from a few days to as many weeks, according to the temperature, many of them no doubt sleeping through the winter. Whilst in this state, the maggot is undergoing a wonderful transformation within his own skin, which at last opens at one end by a little circular lid, and out creeps the House Fly, with its body and six legs as large as they are at any subsequent period of its life,—indeed, the abdomen is often larger, as it is filled with a fluid which is afterwards discharged." A description is also given, unnecessary to enter on in detail here, of the method by which the two wings, which, when the fly comes out of its chrysalis case, are merely two little crumpled up objects placed one on each side of the body, are expanded until they gain the iridescent membranous transparent state in which we are best acquainted with them.†

Referring to duration of the life of the fly in larval and pupal state, together with effects of low temperature in lengthening duration of these conditions, Mr. Edw. A. Butler gives the following remarks:—

"The larval life of the House Fly lasts about a week, during which time the maggot is said to change its skin twice, altering its form to some extent on each occasion. By the end of this time it is full grown, and passes into the pupa condition, which in about another week gives place to the perfect form. . . . They are very dependent on temperature, and unless there is sufficient warmth their development is delayed, and they become more or less dormant; hence all specimens that are in the larval or pupal condition at the approach of

* 'Praktische Insektenkunde,' by Dr. E. L. Taschenberg, pt. iv. p. 104.

† 'Gardeners' Chronicle'; paper by John Curtis, previously referred to.

winter have their further development stopped, and remain in a torpid condition till the returning warmth of spring enables them to complete their cycle of changes." With regard to locality of egg deposit, Mr. Butler considers that this species (*M. domestica*) "does not select meat, but deposits its eggs amongst stable refuse, as the larvæ feed upon horse-dung, of which they eat the softer decaying parts, and leave the bits of hay and straw."*

Dr. J. Ritzema Bos notes that these flies are very objectionable, amongst other reasons, because, although they do not pierce or prick with the proboscis, but only suck the perspiration or moisture of the skin, they have great fondness for settling by the eyes or on the hands. Also our domestic animals are seriously troubled by the great numbers of their infestation. "Most of the House Flies die in autumn, but some live through the winter, and propagate in the spring. Every female lays about seventy eggs in manure heaps, dead animals (Tierleichen), decaying meat, and rotting vegetable matter."† Details of rate of development and other useful information is given accompanying.

In the paper previously quoted from by John Curtis, he gives an observation of this species having been found breeding in rotten potatoes; and with regard to geographical distribution, he notes that he "can state from personal observation that the *Musca domestica* of Canada, the United States, Cape of Good Hope, and Hobart Town, are identically one and the same species with that of England"; and that he thinks "it probable that it is to be found in every part of the world."—(J. C.)

Taking a general view of the life-history of these creatures, it appears that they live throughout the year actively or otherwise as temperature permits; that each female lays a great number of minute eggs, somewhat spindle-shaped, or perhaps better described as cylindrical, blunt at one end, and elongated towards the other; these eggs may range in number from seventy to one hundred and twenty or more, and may hatch in twenty-four hours‡; the maggot condition lasting up to a week, and the chrysalis state likewise; but in pamphlet noted below, even a much more rapid rate of development has been recorded. The point on which there appears to be some difference of opinion, is how far the House Fly, *Musca domestica*, infests moist rotting substances, other than horse manure, for laying purposes, and at present this point seems to me to rest on good authority that, though horse manure

* For passages quoted above, see 'Household Insects,' by Edw. A. Butler, pp. 197 and 200.

† 'Tierische Schadlinge und Nützlinge,' von Dr. J. Ritzema Bos.

‡ For times of rate of development, see experiments by Dr. Packard, quoted p. 25 of 'The Principal Household Insects of the United States,' by L. O. Howard and C. L. Marlatt. Bulletin No. 4, New Series. United States Department of Agriculture, Washington, U.S.A. 1896.

is the chief place of deposit, other foul and putrefying matters are not exempt.

In the above notes I have endeavoured wholly to confine them to observations of this one species, *Musca domestica;* but the various other flies which commonly pass under the name of House Flies much resemble them in many particulars of their life-history, and speaking generally of these "flies," it is obvious that even of those that do not sting, that where the foot has the "pads" covered with hundreds of hollow tubes secreting a viscid fluid by which they adhere to the smoothest surface, and the organs used in taking food consist of minute formations, called teeth, by which the surface of the food is "rasped," and thus new surfaces exposed to the action of the moisture of the fly's mouth, that it is not surprising that delicate parts, such as the surroundings of the eye, should suffer grievously where, as in hot countries, they are buried under the constantly attacking masses of the pests.*

On March 24th of this year Dr. Spooner Hart, of the firm of Messrs. Hart Bros., Calcutta, Veterinary Surgeons to the Viceroy and Governor-General of India, favoured me with a large supply of the fly, of which he observed that it was the worst pest that the Horse had there, and much resembled the common English House Fly. So far as I could myself find by examination, there was no difference, and on submitting some to Mr. O. E. Janson, 44, Great Russell Street, London, he wrote me that, as he could not detect any difference between the specimens that I had sent him and our common House Fly, *Musca domestica*, he had taken them to the British Museum, and Mr. Austen kindly examined them, and said they undoubtedly were of that species, which occurs in nearly all parts of the world.

Dr. Spooner Hart's first observations were sent me from Calcutta on March 24th as follows:—

"I am despatching by this mail a box containing a phial full of Horse Flies. The sample looks to me a common specimen, and like the ordinary House Fly at home, only smaller. It is the worst pest the Horse has here, and at this time of the year it exists in thousands, especially in the suburbs. It attacks in great numbers the eyes principally, and is constantly flying off and coming back all day long to the same site. This, as you can easily understand, causes great irritation and inflammation, which, being continued day after day and neglected, will lead to blindness, disfiguration of the eyes, and ulceration of the face.

"Our hackney carriages (cabs) here are drawn by wretched half-starved ponies that stand about twelve hands to twelve hands two

* For elaborate descriptions, see Mr. Butler's 'Household Insects,' previously referred to.

inches in height, fed principally on grass, out all day exposed to the sun, stabled in filthy holes, and are most disgracefully treated and neglected. Dozens of these unfortunate creatures are blind from irritation set up by these flies, and present huge ulcers on either side of the face just below the eyes, the result of constant lachrymation and irritation of the flies. The eyelids are thickened and averted, and the appearance is awful. The flies are dreadfully persistent, and will not be shaken off. Horses turned loose in the field will be seen following each other, the hinder one carrying his head right in contact with the leader's tail, so that when it swings it brushes the flies away; others will be seen standing close up in twos, head to tail, and so obliging each other; others, again, will be observed standing close up in threes, two tails and a head one way, and one tail and two heads the other way,—the head and the two tails having the best of it; and so they will stand for hours keeping the flies away from their eyes. Eye fringes are worn to protect the eyes from the attacks of these flies, and I am sending you one specimen by this post of the eye fringe used here."

In the case of the very ample supply of specimens sent me by Dr. Hart, these appeared to be all of one species, as amongst all of those which I examined I did not find any differing from the samples identified for me (see p. 80) as being *Musca domestica;* but for the most part, the complaints of "House Fly" presence sent me in this country are so wholly unaccompanied by specimens, that they might refer to any kind of so-called "flies," or fly-like insects, which happen to occur in large numbers. The notes are therefore quite useless as observations; but methods of prevention and remedy may be very similarly brought to bear upon most of what pass under the name of House Flies.

Prevention and Remedies.—Looking first at the larger House Fly, *Musca domestica*, in the point of view of its early stages being passed wholly or chiefly in horse droppings or manure, something might be done by even moderate care and cleanliness to lessen its numbers. The filthy state in which lower class stables and their surroundings are often kept, and the amount of horse droppings left exposed in fields and roads, are of themselves able to breed flies enough to infest all neighbouring houses in legions; and where it is thought worth while, removal of horse droppings, and treating the manure with such insect deterrents as would not spoil its quality for use, would probably save us much annoyance. Lime might injure it, but gas-lime would not have the same effect; and the same principle applied to the various foul substances, or substances in foul and putrid condition, which various well qualified and careful observers consider to be

breeding-places (as well as horse manure) of *M. domestica*, would, if their views are right, save us a great deal of trouble; and (in especial) attention would be well bestowed on garbage thrown to ash-pits, or after the periodical throwing to garden accumulations of the scullery door receptacle for kitchen rubbish, of the rotting contents.

As a preventive of direct attack of flies to horses' ears, eyes, &c., we often in the country see a good branch of green leaves fastened above the head, and apparently answering well; and on May 19th Dr. Hart, writing to me regarding these pests, remarked that "phenyle-water, when freshly put upon the body, would keep the flies away"; and also that "the close eye fringe is all that is required, if the owner will look after it and keep it clean and in proper order."

Of this fringe Dr. Hart kindly sent me a sample. This was about thirteen inches long by nine and a half inches deep, and was formed of about seventy-six hanging strands of white cord, each an eighth of an inch across or rather more. The heading which secured these together was about an inch in width, and though quite flexible, so as not to hurt the Horse, very firm, thick, and durable, and, as far as I could make out, hand-worked over a foundation; each stitch of the lowest row being worked in between the strands of the fringe, so as to alternate with them, kept them firmly placed, and being overcast in red, with a dark blue line above, gave a very neat appearance. A loop of the soft but strong white cord was left at one end of the horizontal heading, and two loose ends at the other, for securing the fringe in place, and each of the hanging strands being *not* cut so as to be fuzzy at the ends, but of one cord doubling up on itself at the extremity, so as to form a firm-ended double-stranded cord, the whole thing was very strong and durable, and apparently admitted of washing. Also, even to the tender human skin, it was no annoyance when placed across the forehead for the fringe to hang over the eyes.

For garden capturing of flies, together with wasps and various other insects, on a large scale, a trap formed of two "hand-lights" set one on the other, and the lowest raised just a little above the ground by each of its corners being placed on a brick set on its side, answers well. The glasses being square-sided, with pointed tops, give a very convenient shape for the work. The finger-hole in the top of the lowest must of course be left open to allow access from it into the upper one, of which the finger-hole must (of course) be closed to prevent exit. This is easily done with a bit of moss, and moss also is a very convenient way of plugging any openings where the lower edge of the upper glass rests on the slanting sides of the top of the lower. The trap is then all ready, and only needs a little fruit, or whatever it is thought may best attract what may be wished to be captured, to be thrown beneath it. In this way insects are attracted

in great numbers, and following their instincts of flying upwards, they rise (when they have fed sufficiently) to the pointed top of the lower glass, where, finding an open hole, they go through, and are secured in such quantities, that I have seen the sides of the upper glass filled inches high with the captured insects.

"In-doors" attempted preventives, such as muslin over the openings of windows, fly-traps, fly-screens, sticky paper to secure flies which may alight upon it, a solution of quassia with plenty of sugar added to attract and poison them, and various other deterrents or possible deterrents, are too well known to require special mention; but for clearing the windows of a room on a sunny day, when the glass seems alive with the buzzing multitudes, the only plan which I know of, and which I have always found to act thoroughly, is one contrived by my late sister, Georgiana Ormerod, who always had great pleasure in adding to the comfort of those about her.

The arrangement is, firstly, to draw down the lower sash of the window, so that it is closely *shut;* then to draw down the upper sash for about a foot, so that it is *open* at the top. Next, draw down the rolling blind, so that the buzzing pests are enclosed between this calico blind and the glass panes of the window. Following their natural instinct, the flies rise, and when they arrive at the opening to the fresh air outside, out they all go.

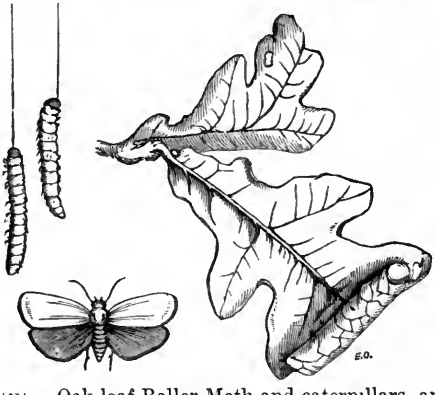
We usually carried out this plan on the side divisions, as being more convenient for management than the large central division of the bay-windows, in the rooms in which the autumn legions of flies troubled us, and I never knew it to fail; the peace and silence which we enjoyed after the preceding commotion was for years a comfort to ourselves, and in case of serious illness might be of great relief to a suffering patient.

The only other plan which I have heard of for broadscale clearance of flies from an infested room is sulphur fumigation, but of this I have no experience; and besides that, the plan could not be carried out in living rooms, where remains of fumes might be very injurious to the in-dwellers, and it might not (in the heating processes) be wholly without danger of setting the house on fire.

Yet one further point may require a word. Where "flies" (as they have been reported to me) appear in vast numbers in an upstairs room from inside the roof, or from somewhere which in itself cannot be supposed to be the breeding-place, it would be highly *desirable* to have inspection by a qualified expert, for it might prove that communication exists between sewers or other repositories of filth, and that the flies might be a sign of something much more prejudicial to the health having means of access in the form of sewer-gas.

LEAFAGE CATERPILLARS.

Oak-leaf Roller Moth. *Tortrix viridana*, Linn.
Mottled Umber Moth. *Hybernia defoliaria*, Linn.
Winter Moth. *Cheimatobia brumata*, Linn.



TORTRIX VIRIDANA.—Oak-leaf Roller Moth and caterpillars, and rolled leaf.

One of the worst insect attacks of the past season has been that of various kinds of caterpillars to leafage of forest and fruit trees. These were most particularly injurious in Oak woods, so completely devastating large areas by their ravages that the mischief was described by resident observers as "a wholesale stripping of the leaves"; or, again, as if "fire had gone over the trees," from their brown and scorched appearance; or, again, as in the Forest of Dean, that in many places "trees might be counted by the hundred without a leaf on them." But, besides damage to Oak-leafage, the caterpillar injury included serious mischief to Lime trees, in one instance to an avenue a mile long, as well as to Beeches, orchard fruit trees, and Hazel coppice, and bushes in the neighbourhood of infested trees, when the leafage of these was consumed.

Injury was reported at various localities in Kent, Sussex, and Surrey, and it was noticeable near St. Albans. Ashby de la Zouch was the most northerly locality from which information was sent me; it was bad in Oak woods near Alcester, in Warwickshire, and a perfect scourge in the Forest of Dean, in Gloucestershire. Bad attack also occurred near Taunton; and in the New Forest, Hampshire, and surrounding manors, "hundreds of acres were stripped of every leaf." The above besides lesser observations.

The caterpillars causing the damage were of various kinds, but most notably the "looper" caterpillars of the Winter Moth, *Cheimatobia brumata*, and of the Mottled Umber Moth, *Hybernia defoliaria*, which

resembles the *C. brumata* in habits, and also the caterpillars of *Tortrix viridana*, the "Oak-leaf Roller" Moth, whose presence may be known by their curling the end of the Oak-leaf into a tunnel for their shelter, and spinning the roll firm with threads. There was also in one locality a very bad attack of Sawfly caterpillars.

The first note of remarkable amount of caterpillar injury to leafage being observable was sent me on May 12th from Ossemsley Manor Farm, Lymington, Hants (a locality close on the border of the New Forest), by Mr. D. D. Gibb, to whom I have long been yearly indebted for careful and valuable observations. Mr. Gibb remarked:—

"We are now getting the usual attack of caterpillars on the Oak, and I may say more or less on all trees. . . . As soon as the buds began to open, the little caterpillars were upon them. I believe, in some cases, Oak trees will scarcely get foliage enough to support life this season, unless rain comes soon to wash the caterpillars off."

On December 15th Mr. Gibb favoured me with the following communication, in which he draws attention to the very important point that, though the attacks of leafage caterpillars have been of late years on the increase, the last two years have been particularly favourable for propagation consequently on the absence of spring rain "*to check the moths and wash off and destroy caterpillars.*" Mr. Gibb observed as follows:—"The caterpillars which destroyed Oak-leafage this year in the New Forest and neighbourhood were various. This pest (as you may be aware) has been greatly on the increase here of late years. The last two years have been particularly favourable for the propagation of these destroyers from the absence of rain in the spring to check the moths, or afterwards wash off and destroy caterpillars. One of the leading officials of the New Forest, who is a native, assures me that this blight, as it is termed, has greatly increased of late. Few trees seemed to escape this year, while hundreds of acres in the New Forest and surrounding manors were stripped of every leaf. Looper caterpillars have been very plentiful the last two seasons, and here added much to the destruction, 'Winter' and 'Mottled Umber' Moths being among those present; but the greatest pest of former years, as well as of late, has been what I take to be the *Tortrix viridana*. . . . The colour of the caterpillar, dirty leaden green, with black head. In the end of July we had a brood which hatched from pupæ or chrysalids adhering to the tree, or stems, or remains of ragged leaves. These moths looked white whilst flying, but when examined closely were of a very pale green or blue."*—(D. D. G.)

* Mr. Gibb mentioned that earlier than the date of the above observations he had noticed moths which appeared to him similar to those hatched from the *T. viridana* chrysalids, except in being of a dirty grey or brown colour. Conjecturally these might be early developed specimens which were in battered state, with the plumage rubbed from the wings.

Later on, on May 20th, writing from Holnicote, Taunton, Mr. C. T. D. Acland observed:—"The Oak trees here are being dreadfully stripped, and in some places the Beeches also."

In the Forest of Dean, in Gloucestershire, the caterpillar ravage was very severe, and, like that in the New Forest, caused by several different kinds of moth caterpillars, of which, so far as I could ascertain by the specimens in the young condition sent, some were of the Mottled Umber Moth, of which the larvæ have been so very widely spread, and so destructive in the past season, and others of the Oak-leaf Roller Moth, *Tortrix viridana*. Other specimens forwarded were not, so far as I am aware, of importance; but amongst them were samples of two good helpers towards keeping down infestation, in the shape of an ichneumon fly, and also the carnivorous green grub of a *Syrphus*, or allied two-winged fly.

On May 29th Mr. Charles Bathurst, Jun., of Lydney Park, Lydney, Gloucestershire, wrote me as follows:—

"We are suffering terrible devastation from injurious larvæ at the present time in and near the Forest of Dean. . . . In many a dry season have I seen the tops of the Oaks in the Forest laid bare, but never have I seen the 'wholesale stripping' which is at present taking place; in many parts of the Forest, trees may be counted by the hundred without a single leaf on them. They are now spreading beyond the confines of the Forest itself, and, not content with forest trees, are commencing a terrible onslaught on fruit trees and garden shrubs. The commonest of all, and apparently the most voracious, is the long and well-marked reddish brown 'looper,' with a red head, yellow lateral lines, and one pair of prolegs only" [*Hybernia defoliaria*.—Ed.]. "There seem to be but few leaves they will not eat; they swarm on the Oak, Elm, Hazel, Whitethorn, and are to be found in myriads on the fruit bushes. They do not appear to do much, if any, damage to the Ash, Beech, or Chestnut."—(C. B.)

Besides these, Mr. Bathurst mentioned another kind of "looper" caterpillar (green, with only one pair of prolegs), which, conjecturally, was of the kind especially known as *the* Winter Moth, and yet another, of which he remarks, "From the description in your book I take this to be the *Tortrix viridana*"; and amongst other things, notices the activity of this caterpillar, and its habit on alarm of darting out of the tunnel, which it has rolled up of a part of the leaf with a silken web, and letting itself so quickly down by a thread that it was impossible to catch it.

The following note, sent me on May 26th from Ragley Gardens, Alcester, Warwickshire, was one of the most northerly records of observation of attack, and refers to presence of "looper" moth caterpillars, and also of Sawfly caterpillars, which I have very rarely, if at

all, had specimens of before as injurious on this large scale to Oak-leafage. The hanging down of the "looper" caterpillars (as those of the Winter and Mottled Umber Moths) by their threads is a characteristic habit, and one which in the course of last year was noticed as the cause of a deal of annoyance. Mr. A. D. Christie, on May 26th, wrote requesting information on specimens sent:—

"No. 1 we have more or less every year in the Oak woods, and at present time are very bad, and most disagreeable for one to walk under the trees, as they hang down with gossamer threads, sticking over one's face and clothes. No. 2 has never been noticed until this year. While some are in the woods, they are most abundant on individual specimen trees in the park, and have no threads or webs, but drop down all over; at the bottom of the stems we can lift them in shovelfuls. The stems themselves are covered with them trying to get up. . . . We are destroying all we can with paraffin, gas-lime, salt, &c., and are more or less successful."

No. 2 proved to be specimens of Sawfly caterpillars, of which the kinds which infest the Oak in this country are considered to be about twelve in number, as noted by Mr. P. Cameron in his 'Monograph' referred to below* (see his list, vol. i. p. 39). There is considerable difficulty in identifying some of the Sawfly larvæ merely from description; but by working on Mr. Cameron's lines, and putting aside, firstly, those which are leaf-miners; secondly, a kind which lives within the swollen end of an Oak-shoot; and, thirdly, those of which the caterpillars appear so customarily in August that they would in no way coincide with the May infestations, and also putting aside two spiny kinds, the specimens now under consideration appear to be almost certainly caterpillars of the Oak-feeding species, *Emphytus tibialis* or *E. serotinus*, and in either case they may be known from moth caterpillars by their greater number of legs, having in all twenty-two,—that is, three pairs of claw-feet, seven pairs of sucker-feet beneath the body, and another pair at the end of the tail.

The *Emphytus serotinus* larvæ are common on the Oaks in June, and also to be found in May, newly hatched on the young leaves. The caterpillars are from four- to five-eighths of an inch long, bare, cylindrical, and having a light green ground, covered all over, as well as the head, by a light green powder; but at the last moult the powder is lost, and the caterpillar becomes yellowish green and shining, the head yellow. These caterpillars were found by Mr. Cameron to change to chrysalis in the ground without spinning a cocoon, and the Sawflies from them appeared in September and October. Therefore

* 'Monograph of British Phytophagous Hymenoptera,' by Peter Cameron. London: printed for the Ray Society.

it was considered by Mr. Cameron (from whom I quote the above *) that the eggs were laid in the autumn, and probably remained unhatched till May of the following year. I have not had opportunity of giving a figure of this species; but just as some sort of guide merely to appearance, my figure of the Apple Sawfly (p. 9) shows the length of this kind, and also size of the fly by the lines, and also the general shape. The fly of *E. serotinus* is shining black.

On June 2nd Mr. P. Chasemore, writing from Ashleigh, Horsham, Sussex, regarding the infestation which was destroying the Oak-leaves, observed:—

"In West Sussex it has, during the last few weeks, in many parts made the woods look more like November than May, and I cannot but think that it will cause a considerable amount of damage to the Oak trees that are so seriously denuded of leaves. As an estate agent, I am anxious to know if there is any means of killing the chrysalis that they now appear turning into? Whilst timber measuring yesterday, I saw on one large Oak tree apparently thousands on the trunk, covered by a thin web."

This quite agrees with the description of the habits of the caterpillars of the little Oak *Tortrix* Moth, which in regular course roll up the ends of the leaves into a kind of cylinder for a shelter during pupation; but if, as in one of these devastating attacks, they have already devoured the leafage which should have been their protection, then instead they take shelter in the crannies of bark on the stems or boughs, and there turn to brown chrysalids, secured under the threads which they have spun.

On June 2nd Mr. Chasemore wrote further:—"Now that the wretched caterpillars have cleared off all the Oak-leaves in one wood, they are beginning to eat the Hazel underwood."

On June 8th Mr. G. B. Buckton, F.R.S., of Weycombe, Haslemere, Surrey, remarked:—"For miles round this parish the Oaks are leafless; whole districts appear as if fire had gone over the trees." He appended a note, ". . . *Tortrix viridana* and a small geometer." Mr. T. P. Newman, of Hazelhurst, Haslemere, also writing from the same neighbourhood, noted, on June 10th, "We have had the Oaks stripped by larvæ of the Winter Moth for miles."

The following carefully detailed notes, with which I was favoured on May 25th by Messrs. John German & Son, of Ashby de la Zouch, regarding treatment of a valuable avenue of Lime trees under their care, are of very useful interest, as showing two important points: one, that if once the Winter Moth attack has become established, it is very difficult to get rid of it again; the other, that though (as we know) sticky bands must demonstrably lessen amount of infestation,

* See work referred to, vol. i. pp. 277–278.

yet still so much moth presence may be conveyed to the trees by methods which evade the barring out of the sticky banding, that this method cannot be wholly trusted to as a preventive, even in the most careful hands,—even where, as in this case, the moths were found to be captured in due course by the bands. Messrs. German wrote as follows:—

"As promised, we have much pleasure in sending you a detailed report of our operations with regard to the attack on the Lime-trees of the moth of the *Cheimatobia brumata*. On October 5th, 7th, and 8th, sticky bands were put on the trees. . . . Bands renewed November 6th and 7th, owing to wind and rain having rendered them useless, and again renewed from November 13th to 20th. On November 27th Morris & Little's antipest was applied round some of the trees on the ground, and on the same date a dressing of freshly slaked lime was applied round others. Fresh sticky bands were put on some of the trees to ascertain if moths ascended after the above applications. Although the earth near the tree trunks was literally alive with moths at the time of the above applications, scarcely any moths were seen to ascend after the dressing of lime, whereas more were noticed on the trees around which the antipest was used.

"On December 11th lime was applied to remainder of trees in avenue, and bands were put on six trees to indicate when the moths again commenced their ascent.

"On March 5th and 6th all old papers were taken off, the trunks of trees were scrubbed with warm water, and sticky bands were renewed on all the trees in the avenue. Very few insects were caught.

"On April 14th and 15th the bands were taken off, and the trunks washed down with paraffin and water.

"The avenue trees were attacked again to a considerable extent, which is rather disappointing, although, of course, we did not expect to cure so extensive an attack in one year.

"It was noticed a few days ago, after a windy night, that many caterpillars were crawling up the trunks of the trees. They were, we suppose, thrown off by the wind, and were again ascending. We think the trees were benefited by the dressing of lime, and that the attack is not quite so bad as last year."—(J. G. & Son.)

The above record, it will be seen, gives full details of most careful operations. We have, to start with, the kind of tree attacked, and the kind of moth caterpillar, namely, the common Winter Moth, *Cheimatobia brumata*, and I may add that I had myself for a long time been, at intervals, in correspondence with Messrs. German regarding this attack. It will be seen that the "sticky-banding" was first applied even before the date which is thought absolutely necessary. On October 5th and following days bands were first applied; on

November 6th and 7th they were renewed, and again renewed from November 13th to 20th After this, various applications were thrown round other trees, and sticky bands applied to ascertain whether the moths were ascending the trees; but although the earth near these tree trunks "was literally alive at the time of the above applications," *scarcely any moths were seen to ascend after the dressing of freshly slaked lime was applied.*

The above observation is very useful practically, for if, as appears, shovelling some lime round the trunks of the trees to be protected answers so well (as is shown by the sticky bands above them having few captures), this plan would be cheaper, more simple in application, and many a grower would have no objection to having some lime shovelled round the stems of his trees, who would not for a minute think of going through the tedious details of wrapping the tree trunks securely in their paper bands and spreading and renewing the grease.

The treatment of Messrs. German was ended in March and April by renewal of the sticky bands on March 5th and 6th, and the bands being taken off on April 14th and 15th, and the trunks washed down with paraffin and water. Nothing could have been more complete, excepting that in the possibility of wingless moths getting up the trees in the period preceding November 6th and 7th before it was possible to replace the bands which had been rendered useless by rain and wind. The lesson taught appears to be that we cannot depend on sticky-banding being more than a palliative; *it must do some good*, but surrounding coincidences,—such as rain, that washes off the sticky material, and wind, that carries the wingless females by the aid of their winged mates to the trees, &c.,—must be taken into consideration; and in our next autumn and winter observation, I certainly think that the use of freshly slaked lime (as above noted) would be a practically serviceable application.

The Lime avenue mentioned above was not the only example of severe injury to valuable Limes from looper caterpillars during the past season. During the visit of the Bath and West of England Society to St. Albans at the end of May, Mr. J. Stanley W. Blackett called on me relatively to information as to the name of the caterpillar injurious to the Lime avenue in Hatfield Park. Writing further, on June 2nd, from St. Michaels, Hatfield, he mentioned that "for a whole mile every leaf is entirely eaten," and that "he was told they were bred in the ground."

Mr. Blackett's careful quotation of the observer's remark is nearly correct, as, on examination of the caterpillars, I found them to be of the Mottled Umber Moth, *Hybernia defoliaria*, of which, like the scarcely more prevalent pest, the common Winter Moth, *C. brumata*, the caterpillars go down into the ground below the trees which they

ravaged, when their feeding time is done, and in due course come up from it again in moth form, after going through their conditions of larva and chrysalis to winged and wingless moths.

The kinds of caterpillars which were especially noticed as doing mischief last season were those of the Winter Moth (*Cheimatobia brumata*), of the Mottled Umber Moth (*Hybernia defoliaria*), and of the Oak-leaf Roller Moth (*Tortrix viridana*). Other kinds were present, but not nearly to such an observable extent; and though the life-history of the above-mentioned kinds is fully known, it may save trouble in reference to give again a short account of each.

The Oak-leaf Roller Moth, figured at p. 84, has the head, the body between the wings, and the fore wings of a light green; the hind wings silver grey or brownish; and both pairs of wings with whitish fringes. The fore wings are about one inch in expanse, and have a whitish line on the front edge. They appear towards the end of June.

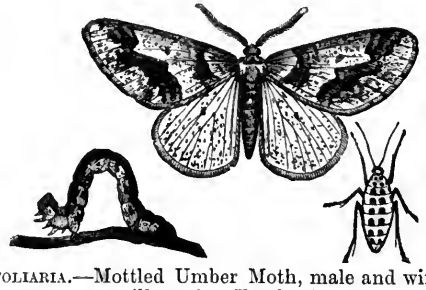
Egg-laying takes place during summer or autumn on some part of the tree,—as, for instance, boughs, &c., or leaf-buds, and in the following spring the caterpillars hatch at the time when the young Oak-leaves are expanding. These caterpillars vary in colour from greenish grey or lead colour, with head and next segment black, in their early life, to dull green afterwards, with the head, edges of the next segment, and patch at the tail, and various smaller details, black. They have some brownish hairs, and are a little more than half an inch long, and are sixteen-footed,—that is, with three pairs of claw-feet, four pairs of sucker-feet beneath the body, and another pair at the end of the tail.

Sometimes, when favoured by circumstances,—as for instance, the weather exactly suiting them,—they appear in myriads, as was recorded as far back as the year 1827, and do immense damage to tree leafage, especially to that of Oaks. They take their popular name from their power of rolling the end of the leaf into a kind of cylinder (see figure, p. 84). This they secure from flying open by spinning it together with threads for a shelter, as a place in which to turn to chrysalids; but on alarm, or apparently simply for their own pleasure, they can let themselves down by threads for six or eight feet, and swing in the air, returning at leisure, each grub up its own thread, to the bough. In case, however, of the great number of caterpillars having so devoured the leafage that there are no tunnels or spun-up remains of leaves left for them to turn to chrysalids in, then the caterpillars shelter themselves instead in such crannies as they can find in the bark or boughs, securing themselves by a covering of spun threads (see p. 85).

The chrysalids are of a blackish brown varied with red, and from these the moths for the most part come out towards the end of June

or the beginning of July, and lay their eggs (as above mentioned), from which the caterpillars hatch out at the time of the leafage of the Oaks in the following year.

The two kinds of looper moth caterpillars which have been so destructive in the past season are so similar in their habits, that one description of life-history will be sufficient for both. The two figures show the difference in size of the two kinds; and also that whilst in the Mottled Umber Moth the female is entirely wingless, the female of the Winter Moth has the wings represented by stumps.



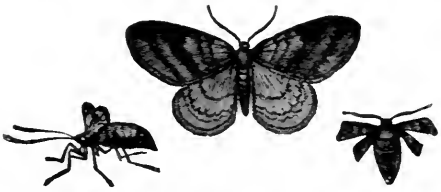
HYBERNIA DEFOLIARIA.—Mottled Umber Moth, male and wingless female; caterpillar, after Taschenberg.

The caterpillars, like others especially known as "loopers," have instead of four pairs of sucker-feet below the body, only one pair of these "prolegs," besides the pair at the end of the tail; so that in walking they cannot progress forward continuously, but have to bring the sucker-feet and tail-suckers forward to where they are held firm by the claw-feet (as shown in figure), and thus it forms an upright "loop," whence the name of "looper." When full-fed, which may be, according to circumstances, from towards the latter part of May even until the beginning of July, the caterpillars leave the trees, and go down to the ground, where they turn to chrysalids at or a little below the surface. From these, in common rule (though some may remain unchanged till spring), the moths come up in autumn. The development begins in October, and may last till December, and even occur later irregularly till spring, which causes great difficulty in certainty of prevention by sticky-banding.

The female moths creep up the trees and lay their eggs on buds or twigs, or in crevices of the bark, or in the little furrow between the extremity of the cut-back twigs and the bark healing over the edge. From these eggs the little caterpillars come out towards the end of March, or, speaking more generally, when their food is ready for them, and as they grow (in years of bad attack), devour indiscriminately all they can reach, whether buds, or flowers, or leaves, or growing fruit, until, as noticed in the past year, the ravaged tree, with the remains of the destroyed spun-up leafage, looks as if it had been

scorched by fire, and, if the leafage that is preferred falls short, they make up as well as they can from what may be at hand in the neighbourhood, and feed till the time comes for them to go down for their chrysalis change.

This is the general history of our two most destructive kinds of loopers. The Winter Moths (see figure) are smaller than the other



CHEIMATOBIA BRUMATA.—Winter Moth, winged male, and abortive winged females.

kind, and are of a greyish colour. In the male moths the fore wings are ash or brown grey with an ochrey tint, and marked with several cross-bars; the hind wings pale. The female moths are grey. The caterpillars vary very much in colour, and are, as far as I have observed, when nearly full-grown, usually of some shade of greenish, with a few faint white longitudinal lines. But they may be smoky brown or even blackish. When full-grown they are about half an inch long.

The Mottled Umber Moth is about twice the size of the Winter Moth (see figures). The male has the fore wings usually of a pale brown or reddish yellow, with dark transverse bands and some slighter markings, and the hind wings paler, with a very small dark spot in the middle; but "sometimes the wings are merely of a reddish brown, freckled over with minute dots." The female moth is brown; and the two dark spots on the back of each segment, as figured, are very conspicuous.

The caterpillar is brown or of a reddish brown above, this bounded on each side by a very narrow waved black stripe, and below this the body is bright yellow; it is very distinguishable by its brilliant colouring.

The various other caterpillars which helped at the leaf ravage were so comparatively unimportant in number that they do not need description, with the exception of the Sawfly caterpillars, which it would be well for all concerned to know by sight, as, in the case at least of this attack, it might be got under successfully and certainly with very little expense, and at p. 87 are some notes to help towards identification of this kind of infestation.

PREVENTION AND REMEDIES.—Where we can get access to trees, as in fruit grounds, orchards, or park-land, preventive measures, such as

what are known as "sticky-banding," may commonly be used with great success towards lessening amount of wingless moths making their way up the trees for egg-laying, as is shown by the numbers of moths caught during their attempted transit. But where, from any cause, these measures are only partially successful, or, again, infestation occurs consequently on caterpillar presence from the egg-laying of moths which fly to the trees (instead of creeping up the stems), this (*where we have access to the trees*) may be got rid of cheaply and certainly by means of various washings and sprayings, of which I give details further on.

But with regard to ravages of leafage caterpillars in the past, and to some degree the preceding seasons, as especially injurious to woodland and forest Oak-leafage, there are some other important points to be considered. In the case of large areas thickly covered with timber trees, especially if (as I have experience of in some parts of the west of England) there is such a dense undergrowth of different kinds that it is necessary for paths to be cut to enable even the sportsmen to penetrate, it is a complete impossibility to carry out either preventive or remedial measures successfully; even if it was *possible* to lay water on for washing down the grubs, or to cut passages for the spraying engines, the vast outlay would be without pecuniary return.

But though at present there does not seem to be any artificial way in which we can cope with caterpillars as wood and forest pests, it seems to me to be quite open to reasonable hope that this exceptional amount of attack will lessen, when the month of May ceases to be, as it has been for at least two years, *exceptionally favourable* (by reason of absence of ordinary amount of rainfall) to existence of caterpillars and insect development.

If we turn, firstly, to the reports of droughts in Symons's 'British Rainfall for 1895,' * we find that, compared with the average from 1888 to 1894, 1895 had nearly forty per cent. more than the average number both of "absolute" and "partial" droughts.† "If we break the eight year period into two of four years each, we shall find that droughts in the last four years have been nearly twice as severe as in the previous four years. Turning now to the tables themselves. . . . We have the 'partial' drought in May and June, and, lastly, the 'absolute' drought, chiefly in the south of England, of between two and three weeks, during the hot weather in the latter part of

* 'British Rainfall, 1895,' by G. J. Symons, F.R.S., and H. Sowerby Wallis. Edw. Stanford, Cockspur Street, S.W.

† Technically an *absolute* drought is a period of *more* than fourteen consecutive days *absolutely* without measurable rainfall. A *partial* drought is a period of *more* than twenty-eight consecutive days, the aggregate rainfall of which does not exceed one-hundredth of an inch per diem.—(See 'British Rainfall for 1895,' p. 130.)

September"; and in the same volume, p. 143, in "Notes of the Months," it is recorded under the head MAY:—"A dry month, very few places at which an inch of rain fell, . . . except in the north of Scotland and the south and north-west of Ireland. Below the average at almost every station."

In the above notes it will be seen we have record of much drought generally in 1895, and especially of drought in May and also in the last half of September, such as might be expected (from what has been recorded of *injurious* effect of rain-storms on caterpillars) to be very *favourable* to their prevalence and destructiveness in May; and probably also favourable to the development of the Winter Moths, which make the first appearance about the second week in October. Relatively to this point, one of my observers, writing from near Maidstone, mentioned that the *Cheimatobia brumata, the* "Winter Moth," appeared again in *enormous numbers* in the autumn, as also did the *Hybernia defoliaria*, another species of winter appearing moth. The above is the weather record of 1895, in which eggs were laid and caterpillars grown to continue ravage to 1896.

In the now past year (1896) the report for the quarter ending June 30th was that the weather was "remarkably fine and bright.* But little rain fell in April and May,—in fact, during May at several stations in the south-west rain fell on one day only. May was probably the sunniest month on record; the general character of the weather during that month may be briefly described as—days bright, cloudless, and hot."

In the 'Meteorology of England during the quarter ending June 30th, 1896,' by James Glaisher, Esq., F.R.S., &c., at p. 9 of publication quoted below, ". . . the April fall of rain was small and below its average at all stations. The weather in May was remarkable for its small rainfall, unusual amount of sunshine, and fineness generally. . . . The fall of rain was small, and greatly below its average. The total fall of rain in April and May at Greenwich was ·83 in." [that is, a little more than three-quarters of an inch.—ED.], "and there are only three instances of as small or smaller fall in these two months in the preceding eighty-one years." The great drought of May is further shown (same page) by a table of returns of numbers of consecutive days without rainfall. By this it appears that at thirty-two stations there were periods dating from about the end of April to about the 20th of May (all dates and details given) in which there was no rainfall, these periods running from about seventeen to twenty consecutive days' drought, with the exception of one instance of only nine days, where the drought was broken by a short thunderstorm,

* See 'The Meteorological Record for the Quarter ending June 30th, 1896,' by William Marriott, F.R.Met.Soc., Assistant Secretary of Meteorological Society.

and another where the drought was of thirty-three days' duration, being from April 17th to May 21st.

The above notes appear to be of practical interest, as showing that together with this remarkable prevalence of leafage caterpillars we have had the weather considered to be favourable for this state of things, and therefore we might hope that with return to ordinary weather the special prevalence would disappear.

Notes of method of treatment which have been found to answer in lessening amount of mischief have been for some years before the public in this series of reports, but I repeat some of the recipes to save trouble in reference. The two great points that we need to secure if possible are, firstly, *prevention* of infestation being started by egg-laying of wingless moths creeping up the trunks of the trees; and secondly, *remedial measures*, such as washings and sprayings, which,—where caterpillars do appear, as they often may in quantities, from egg-laying of many different kinds of moths,—will poison the leafage food of the grubs, or simply do good by washing them off, cleaning down the leaves, and helping growth in hot weather by the general application of moisture into and under the tree.

To prevent the wingless moths ascending the trees, the best treatment which is known is what is called "sticky-banding." For this, the chief points are to use a grease or preparation which will continue sticky, but not be moist enough to run down, and also (and this point is of *vital importance*) so to apply it as not to injure the bark and underlying tissues of the tree. The safest plan is to band on strips of common strong grease-proof paper. This can easily be procured at a small cost, and cut in strips of about seven inches wide, or of whatever width may be wished. The length may vary or not with the size of the tree, for there is no harm in the ends of the strip overlying each other. The method of application is for the strip to be placed round the tree, and fixed firmly either by being tied securely with string passed round near the upper and also the lower edge, or by running a band of paste beneath the overlapping end of the paper, and thus keeping it fixed safely down on the rest of the paper. On this strip the grease may be painted, or it may be smeared on with a smooth bit of wood like a paper knife, and thus all or much of the risk of grease soaking into the bark be avoided.

Tar should certainly *never be applied to the bark;* and, judging from a specimen of "tar-greasing" submitted to me, I should say that even for use on grease-proof paper that an admixture of tar with the grease, or the use of the kinds of "axle-grease" containing petroleum or petroleum residue, would be very unsafe. The mixture of tar-grease on grease-proof paper sent me had been very successful in catching the male and female moths, but at the date of examination I found

that the back of the long strip of "grease-proof" paper was of a deep brown from the tar, or tar and grease together, having soddened through from the front. The extent of the mischief in a case like this would be nothing to compare with that of tar banding on the bark itself, but might do much harm by penetrating into the outer coats of the bark. On quite old trees where the bark is very thick and dead on the outside it is not of so much importance to keep it free from all taint of grease, but still care is desirable; and on young trees the matter is of vital importance.

Common cart-grease, harmless when spread on grease-proof paper, may be made of a mixture of tallow, palm oil, and soft-soap; or tallow, palm oil, and caustic soda; or of a more or less perfectly-formed soap, water, carbonate of soda, and neutral fat; or a soap of lime and rosin oil, with or without water; or, again, there is what is known as "Frazer's axle-grease," which consists of rosin oil of various numbers, saponified with a solution of sal-soda in water and softened lime. These two rosin recipes are very similar to a composition which has been found to answer well for use at the Toddington fruit grounds. Grease-proof paper may be bought at the grocers.

Where young trees are tied to stakes, or trees of any age are protected from biting of animals by rough sticks being tied round the stem, care must of course be taken that these are not allowed to be highways for moth traffic. The guards might be perhaps taken away temporarily, and the stakes might certainly be tarred.

Greased hay ropes laid on the ground so as to encircle the tree to be guarded sometimes answer very well. In the course of some observations with which I was favoured on November 20th, 1890, by Mr. Arkwright, of Hampton Court, Leominster, he gave me the following note:—

"I visited my orchards which have been treated with cart-grease three weeks ago, and found the hay bands in perfect order and catching every living creeper. The grease had not melted or hardened, and I am perfectly certain that no crawling creature could pass the band.

"I twisted hay round a piece of cocoa-nut string such as they use for Hops, and tied it as tight as I could round the trees; afterwards painting the under angle of outside with the common grease bought in tins for cart wheels. Common cart-grease bought in 14 lb. tins at Ballow & Co., Leominster. It comes to about 2d. a pound."—(J. H. A.)

The sample sent me appeared perfectly adapted to the work needed, for the grease was still so soft and tenacious that it did away with the objections sometimes raised to this kind of protection, namely, that the moths might harbour under the edge; it seemed perfectly unlikely

that the moths would be able to find successful shelter beneath the sodden grease mass.

In the case of grease-banding the stems of the trees, eggs will often be found in numbers on the bands, produced by the moths which have been stuck fast in their attempted ascent, and some of these eggs, and many of those which are often to be found under the lower edge of the band, would in all probability hatch in due time, and furnish caterpillars for new attack.

To get rid of these, Dr. James Fletcher, Entomologist of the Experimental Farms of the Board of Agriculture, Ontario, Canada, than whom we could have no sounder adviser, wrote me as follows :—"For washing the trunk to destroy all eggs which may have been laid in the winter, a kerosene emulsion may be used." This should be done early enough in March or even in February to make sure of destroying the eggs before the caterpillars have hatched.

The following notes give recipes for preparation of kerosene emulsion, or mixtures which have been reported on trustworthy authority as answering in the United States of America and Canada; in this country paraffin oil, which is more commonly used than kerosene, may be substituted for it, but it should be carefully borne in mind that whether for use on tender bark or on leafage, for which these washes are particularly serviceable where Paris-green spraying is objected to, the strength should always be tried before using on a large scale. I give the recipes with authorities appended.

Kerosene and Soap Mixture.—"To make this I use one-fourth of a pound of hard soap, preferably whale oil soap, and one quart of water. This is heated till the soap is dissolved, when one pint of kerosene oil is added, and the whole agitated till a permanent mixture or emulsion is formed. The agitation is easily secured by use of a force-pump pumping the liquid with force back into the vessel holding it. I then add water, so that there shall be kerosene in the proportion of one to fifteen."—(Prof. A. J. Cook, in Bulletin 26 of the Agricultural College, Michigan, U.S.A.)

Another recipe is for "kerosene emulsion" of the ordinary strength for general application, *viz.* kerosene or refined coal oil, one pint; common laundry soap, half ounce; rain-water, half pint. The soap was boiled in the water till all was dissolved, then the boiling soap-suds were poured into a watering-pot containing the kerosene, and churned with a garden-syringe until the emulsion was complete. This generally takes about five minutes, but sometimes longer. When this emulsion is made, it can be bottled up for future use. When using it, either as a wash for sponging trees or for spraying, it must be diluted with nine times the quantity of water. Should the oil in the emulsion after a time separate, it is well to warm it, and by violently shaking the

bottle it will again become fit for use. In diluting the emulsion use warm water. See p. 14 of 'Report of Entomologist and Botanist, Department of Agriculture, Canada,' 1887.

The following recipe is one of the Department of Agriculture of the United States of America. In this the plan is to add one gallon of water in which a quarter of a pound of soft-soap (or any other coarse soap preferred) has been dissolved, boiling or hot, to two gallons of petroleum or other mineral oil. The mixture is then churned, as it were, together by means of a spray-nozzled syringe or double-action pump, for ten minutes, by means of which the oil, soap, and water, are so thoroughly combined that the mixture settles down into a cream-like consistency, and does not, if the operation has been properly performed, separate again. This is used diluted with some three or four times its bulk of water for a watering; if required for a wash, at least nine times its bulk is needed—that is, three gallons of "emulsion," as it is termed, make thirty gallons of wash. Warning is given that care must be taken with each new crop to ascertain the strength that can be borne by the leafage, and this equally applies to all applications to live bark.

Other formulas have been constantly brought out up to the present time, many of which have probably their special recommendations, but I am not aware that any of them are more serviceable than the above. One point, however, of recent date well deserves attention, namely, the preferableness of use of *soft rather than hard water* for making the emulsion.

In the useful work by Prof. John B. Smith, previously quoted,* at p. 443, is the remark :—

"It is worthy of note that the emulsion is much more easily made with soft water, and if the water is very hard a permanent emulsion is difficult to procure. It is always advisable, therefore, to use rain-water, or to soften the hard water by adding soda or borax."—(J. B. S.)

With regard to time of beginning and leaving off grease-banding there is no doubt that, as the moths have been observed going up the trees on October 11th, the bands should be on by that time, and they may very likely need to be kept in working order by re-greasing up to the beginning of December. Further than this it seems impossible to lay down any rule. The moths may appear again at uncertain times, at the end of January for instance, or a late brood may come up towards or in March, or the wingless females of the March Moth (*Anisopteryx æscularia*) may make their way up the trees and lay their bands of

* 'Economic Entomology,' by John B. Smith, Sc.D., Professor of Entomology in Rutger's College, New Brunswick, New Jersey, U.S.A. J. B. Lippincott Co., Philadelphia, 1896.

down-embedded eggs on the twigs, and especially on Plum twigs, in the month from which they take their name.

It is these successions and uncertainties of appearance, besides some occasional peculiarities in methods of transmission, which cause failures even in the most carefully carried out methods of grease-banding. Nothing could have been more carefully and systematically managed than that of Messrs. German (see p. 89), yet it was only partially successful. Conjecturally the washing off of the grease by the heavy rain gave a period of unprotected free passage, of which the moths availed themselves. Conjecturally also the high wind assisted in carrying many pairs to the boughs of the trees, a difficulty in the way of perfect prevention of infestation of the female moth which the habit of the winged males of flying with them at pleasure to boughs or twigs appears impossible to meet on forest trees or orchard trees of high growth. *In this matter late pruning* and burning all the pruned off-shoots is a very good practice, because the Winter Moth is considered to lay her eggs by preference towards the ends of the shoots; therefore where these are cut off and burnt, when the chief laying season is over, which might be put about the middle of December, much infestation is got rid of.

In the course of previous observations with which I was favoured by Mr. C. Lee Campbell, of Glewstone Court, Ross, he mentioned relatively to this method of destruction of Winter Moth eggs:—

"I have found that an enormous proportion of the eggs are deposited at the end of every branch pruned in the autumn, as much as fifty eggs being found on one branch. At a moderate calculation my men have thus destroyed some 6,000,000 eggs on 5000 to 6000 pyramid fruit trees within the past months, in addition to a very large number caught through greasing the stems."—(C. L. C.)

In what I may truly call an enormous collection of trimmings from Pear trees (the result of three men's work during three hours, sent me a little after the 10th of March, a few years ago, by Mr. C. Lee Campbell), it was made very plain that the moths particularly selected the little furrow between the wood and the bark where shoots had been cut back, for egg-deposit; at the truncated end of these cut-back twigs, or small boughs, the Winter Moths had laid their eggs in such numbers that the little specks could be seen with the naked eye, arranged so as to form a ring more or less scattered just inside the bark, which had healed since pruning, and so made an outside line of protection to the eggs.

Many different methods of treatment have been advised by different writers, such as skimming the surface of the ground to get rid of the chrysalids, or jarring caterpillar-infested trees to make the grubs fall; but there does not seem to be any one of these measures so generally

approved of and adopted for a preventive of Winter Moth infestation as grease-banding. But where this has failed, or not been properly tried, or, which is very likely or is almost certain to happen, there is infestation of other kinds of caterpillars on the leafage of which the egg-laying moths have come on the wing, then our resources lie almost entirely in sprayings to poison their food, or to kill them by external application.

We need an application which can be brought to bear at once, and which will destroy the caterpillars without hurting the leafage, and for this purpose spraying with a very weak mixture of Paris-green answers well as a means of poisoning the grubs internally (by means of their food), or kerosene emulsion (see p. 98) acts well from the outside. Dr. John B. Smith, in his recent work (previously quoted above), says of this application at p. 442 :—"Among the contact poisons none ranks higher than kerosene, either pure or made into an emulsion with soap. Pure kerosene is fatal to almost all insects; it is extremely penetrating, and works its way through the spiracles into the body cavity, and through the trachea into all parts of it. This results in the prompt choking of the insect."—(J. B. S.) As noted at p. 99, the strength of the mixture should always be tested, or irreparable damage may very rapidly be done on a large scale.

With regard to Paris-green, the great amount of successive observations which have been published on the details of its application make it quite impossible to enter on them at length here, so I only endeavour to give some of the most important points, but will be happy to reply to any enquiries to the best of my power.

For liquid application.—The amount recommended for spraying for Codlin Moth or young "looper" caterpillar is "not more than from 2 to 4 ozs. in 40 (forty) gallons of water, or $\frac{1}{8}$ to $\frac{1}{4}$ oz. in a pail of water" [4 gallons, E. A. O.], "to be applied as a fine spray by means of a force-pump. The foliage must not be drenched, but the spray should only be allowed to fall upon the trees until it begins to drop from the leaves. First mix the Paris-green separately with a small quantity of water, then add to it the whole supply. All washes containing Paris-green must be constantly stirred to keep it in suspension, or it will sink to the bottom."

In the observations sent me during special experiments at the Toddington Fruit Grounds by the superintendent, Capt. Corbett, he remarked: "The proportions I fixed upon after the first trials, *viz.* one ounce to ten gallons of water for Plums, and one ounce to twenty gallons of water for Apples, *must not be exceeded;* even with these proportions I think the ends of the leaves in some cases have been scorched."

Dr. J. Fletcher, Entomologist of the Experimental Farms of the

Department of Agriculture, Ontario, Canada, who assisted us greatly by his advice, noted :—"One great point is to insist on the mixture not being made too strong; one pound to two hundred gallons I find very useful, and I never use stronger than one pound to one hundred and twenty gallons."—(J. F.)

Dr. J. B. Smith, in his work above referred to, notes that Paris-green, "for most insects, will be effective when applied in liquid form at the rate of one pound in two hundred gallons of water."

In mixing and in the use of Paris-green as a fluid dressing, it is to be remembered that it does not dissolve in water, it is only held in suspension. It is very heavy, and will keep sinking to the bottom of the barrel or machine unless constantly agitated, therefore the mixture should be constantly stirred, and the barrel well washed out after being refilled several times, otherwise the residue will keep accumulating, and the mixture be too strong near the bottom.

With regard to method of application of the spray.—This should be thrown so finely as to reach all parts of the tree and both sides of the leaves, and coat the leaves as with a fine dew, but it should *not* be allowed to run down and drip. As soon as dripping begins spraying should cease.

Also, spraying should not be done whilst the trees are in blossom, and sprayings should not be given in rapid succession. Several days should elapse between, unless, of course, as may easily happen in difficulties of first experiments, the spray was manifestly so weak that the previous application counted for nothing. The effect of the Paris-green on the caterpillars does not always show directly, and it is undesirable to waste labour and material where the work is already done, and only requires a day or two to show it.

With regard to the nature of Paris-green, or emerald-green, as it is sometimes called, it is an aceto-arsenite of copper, and of a poisonous nature, or, if by mishap swallowed in any large amount, is (as we see in the case of the insects feeding on the poisoned leafage) a deadly poison. *It should never be used to fruit or to vegetables to be used for food.*

Cautions to be observed in the use of Paris-green.—The bags should be labelled Poison and kept locked up, and especially kept safely out of the way of children, who might be attracted by the beautiful colour.

Workers with the powder should not allow it to settle in any sore or crack in the skin of the hands, or stir it about unnecessarily with the hands; and they should be *very careful not to breathe in the powder* through mouth or nose whilst measuring or mixing it. It can be procured from Messrs. Blundell & Spence, Hull, in damped condition, which saves much risk from inhaling the powder. Also it is now procurable in much finer powder than was the case at first, and as this goes much further in using than the coarser grain, this must be

borne in mind, or the leafage will very likely be ruined. The proportions I give are those for the coarse powder, but in every case the strength of the mixture should be tested before broadscale use.

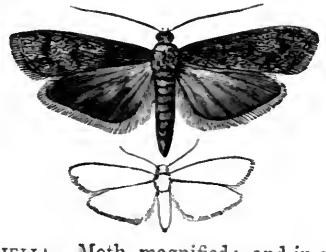
Much has been usefully written on advantages of mixing the powder with plaster or lime, or using milk instead of water for diluting, but space forbids entering on these points here; as well as on the great variety of sprayers which have gradually been invented or improved with the increased use of the arsenite.

But amongst them the form known as the knapsack sprayer (sold by Messrs. Chas. Clark & Co., Windsor Chambers, Great St. Helen's, E.C.) should perhaps be mentioned, as it can conveniently be carried on the shoulders in nursery grounds where a wheeled machine could not pass; and also in selecting machines or nozzles it is very important to choose such as will deliver the spray as a *fine general mist*, not as a wash.

London-purple, which is an arsenite of lime, and also poisonous, may be used similarly to the above, and I have had good results reported in proportion of one pound to two hundred gallons of water. This is procurable from Messrs. Hemingway & Co., 60, Mark Lane, London, E.C.

MILL MOTH.

Mediterranean Mill or **Flour Moth.** *Ephestia Kuhniella*, Zeller.



EPHESTIA KUHNIELLA.—Moth, magnified; and in outline, life size.

The Mediterranean Mill or Flour Moth,—which was first recorded as observed on the Continent in 1877,* as injurious in Holland in 1879, and first noticed as mischievous in this country in 1887,—is now thoroughly established with us as a perfect pest in any roller

* In that year M. Kuhn sent the moth and its larva to Prof. Zeller, of Halle, Germany, by whom it was described in the 'Stettiner Entomologische Zeitung,' and who named the species *Kuhniella*, after its first observer, M. Kuhn.

flour mill where it once gets a footing, and also is to be found in bakeries, or the like places, where the flour, on which its caterpillars feed, is present; and consequently now (and for some time back) is in the course of unchecked spread, which has given the infestation thorough establishment.

The mischief is caused by the extraordinary power possessed by the caterpillars of spinning up the flour into little clots, or large masses, of such a solid nature that these may be taken up without a grain of the flour falling down. The moths lay their eggs on flour or "branny" stuffs, or on flour sacks, and the caterpillars (which hatch in a few days) in the latter case are mischievous by working through the sack into the outer part of the flour, and spinning it up with their threads; but in the mill infestation the attack is overwhelming in all directions. In the words of one of my milling correspondents, "they get into the spouts and machinery, and do no end of mischief, both by destroying the silks and stopping the flow of flour, &c., in the spouts by spinning their web and hanging there"; and the infestation in moth, chrysalis, or caterpillar state may be found everywhere, whether in cracks or crevices, or on walls or ceilings, or infesting the machinery, even to the bands of the elevators, which, from the high velocity at which they are almost constantly running, might be expected to be safe from the pest.

The moth is of the size figured, in outline, at p. 103,—that is, about an inch in expanse of the fore wings. The colour of these is grey, varying in depth of tint in different specimens, with various darker markings, as also figured, magnified, p. 103. The hind wings are whitish and semi-transparent, with a darker line along the fore edge.

The caterpillars, which I have had from about two- to five-eighths of an inch in length, are cylindrical, sixteen-footed, and slender; fleshy or pale red when young, almost white in the older specimens. The head, and a patch on the segment behind the head, yellowish brown; and on the last segment a brownish oval or triangular patch; and along the back there were dark spots, for the most part four on each segment. The caterpillar was slightly sprinkled with pale hairs or fine bristles, and had such a power of catching and retaining flour-dust that I had constantly to remove it by application of moisture to get a clear view of the markings.

The caterpillars turn to chrysalids in silken cocoons spun in the flour in which they feed, and show the general appearance of the coming moth plainly; the colour is bees-wax below, shading to reddish brown on the back, and reddish brown also at the end of the tail, which is somewhat prolonged, slightly curved, and ending bluntly or cylindrically. The eyes are red. From this chrysalis state the moths are stated to come out in three weeks.

During the past year information was sent, as before, with regard to the great trouble caused by this infestation as a mill pest, and more observation than I had previously received of it occurring (and not thought of at all in the light of getting rid of it) in neglected corners of bakers' flour stores.

No further information, however, was contributed as to remedial measures beyond those already known, of turning on hot steam, and also fumigating with sulphur, &c., which, though beneficial in clearing the pests, may in some cases do so much harm to the outside of the flour within sacks left exposed to the fumigation, that this treatment requires great care. The attack and remedies have been gone into at great length in my Twelfth, Thirteenth, Fourteenth, and Fifteenth Annual Reports.

But in the past year, whilst collecting illustrations of economic entomology for exhibition at the show of the Bath and West of England Society at St. Albans, a piece of felted-up flour was sent me which gave an interesting example of the length of time in which successive generations would appear out of one small mass of flour, and the amount of multiplication.

The specimen of flour was received by me in the autumn of 1895, on or about October 7th, and I placed it in a box twelve inches by eight, and two and a half inches deep, with a glass top, so as to allow of observation, and so specially made that the caterpillars could not escape. Only a very little infestation was noticeable on receipt, and the first caterpillar spun up on October 13th. The box stood on a side table in my study, where the temperature was of the ordinary warmth of sitting-rooms, and where it could always be under observation during the winter; the moths continuing to make their appearance until, on April 6th, there were, on careful counting, approximately, four hundred in the box. Of these many had died, but some were living, apparently in excellent health, and the plumage of their wings in such good unrubbed condition that it showed they had very lately come out of their chrysalis-cases, and this, together with the presence of the live caterpillars and chrysalids, showing that multiplication was still going on.

The flour was now felted together by the caterpillars' threads into a mass ten inches long by six inches wide, forming a layer of variable thickness up to about an inch in the thickest part. The whole mass webbed firmly together throughout, and also webbed to the paper on which it was placed at the bottom of the box.

On April 14th the box was accidentally let fall on a wooden floor with such a sharp jar that the mass of felted-together flour was loosened from its webbings at the bottom of the box, and in a very short time I saw two nearly full-grown caterpillars and one about a

quarter grown ranging about in search of shelter, and shortly after as many as seven; these, together with the number of live moths, showing that the infestation was still, at the distance of six months and a week from receipt of the felted-up flour, multiplying to an appreciable extent, and at the end of May, when the specimen was exhibited at the show of the Bath and West of England Society, moths were still appearing.

The above observation seems to me to be of some practical interest, as showing the capacity of the caterpillars for living on and multiplying, when developed to moth state, for a time (at least), amounting to very nearly a period of eight months, where small collections of flour or meal are left undisturbed for them to breed in.

This shows the truth of the observations of some of our best millers, that scrupulous cleanliness is one method for keeping the infestation in some sort of check; and also gives a hint that it would be desirable to see what sort of state the bins or neglected corners and crannies of flour or meal stores of the bakers with whom the millers deal may be in.

In my own investigations I have found the presence of these moths in such localities as the above treated as quite unimportant, and thus, in transit to and fro of infested flour and sacks, the pest is constantly being spread, where moderate care in various quite obvious ways, and especially baking or disinfecting the sacks, would be all that was requisite remedially.

The infestation is chiefly noticed in connection with wheat flour, and occurs in the coarser form known as meal, also sometimes to a very injurious extent in biscuits. It has also been found in rice-cones.*

* '*Ephestia Kuhniella*, Parasite des Blés, des Farines, et des Biscuits,' par M. J. Danysz, Directeur du Laboratoire de Parasitologie Végétale, Paris, 1893, pp. 58, gives the most useful account of this attack that I am acquainted with, both practically and scientifically.—E. A. O.

ONIONS.

Eelworm "Onion-sickness." *Tylenchus devastatrix*, Kuhn.

Eelworm-sick Onion, the outer scales cracked open by the swelled growth of the inner infested scales.

On June 9th I received a number of young Onion plants much deformed in growth, and infested within by the Stem Eelworm, *Tylenchus devastatrix*, which we know best in this country as causing "Tulip-root" in Oat plants, and "Stem-sickness" in Clover, and which has been well known for about twelve years in Holland as causing the disease known as Eelworm "Onion-sickness." Probably, now that attention is directed to it, we shall find that the disease is very widely distributed here, and is often the cause of the cracking open of Onions, or total failure of the crop (for no known reason) on some special piece of ground; but up to date of the specimens being sent me, I am not aware of the attack having been observed, or at least brought under technical notice, in this country.

On June 9th I was favoured with the first observations by the Rev. Charles Pratt, from The Elms, Ashby-de-la-Zouch, Leicestershire, specimens being sent accompanying, of which Mr. Pratt observed:—

"My gardener assures me that it is not the Onion Maggot, but it is a very severe scourge. The neck of the stalk just above the bulb begins to swell, and the swelling increases (if the plant is left alive) very considerably until it becomes a soft pulpy neck, and the bulb

(which *looks* much like a good one) *is* quite soft and squashy. The roots mostly perish, and the plant comes up with the slightest pull. The diseased Onions are mostly in patches, and often all down the middle of the bed, far more than at the ends. I have suffered for many years, and if you will tell me what to do, I shall be very grateful."—(C. P.)

The specimens sent were about thirty in number, ranging from five to six inches high, and gave excellent examples of different early forms of diseased growth caused by presence of Stem Eelworm (*T. devastatrix*).

In one form the general growth was distorted, and the large leaf or flag swollen, and at one side of the bulb were mis-shapen side growths, these again throwing out other small pointed side growths, more resembling the branching of roots than normal leaf growth of bulbs. In another form the distorted malformed shoots from the base of the bulb were almost like curved flat claws, and turned downwards into the ground; in yet another form, instead of being of the tapering shape of a healthy young Onion-bulb, it was more like a square knob. The distorted growths from the base of the bulb strongly resembled, both in their pale yellowish colour and their bent narrow growths, those often noticeable round the bulb-like swelled base of Tulip-rooted Oat plants.

The tumid swelled growth of one or more of the leaves of the diseased young Onions was a very frequently observable characteristic; and inside the bulbs of the infested plants I found the Eelworms in great numbers. Many of these Nematodes were still quite young,—by estimate, some of them were hardly an eighth of the length of the largest specimens, in some I was able to detect the spear and its bulbed base in the gullet (see Plate), which is to some degree a characteristic of this kind of Eelworm.

These Nematode-worms being at full growth only about one-twenty-fifth of an inch in length, and one-thirty-second part of their length in width, it is almost impossible for any ordinary observer to make out *trustworthily* the minute points of structure which are the specific characteristics of these little wormlets. Therefore, in order to be absolutely certain of the species, I forwarded specimens to Dr. J. Ritzema Bos, Director of the Phytopathological Laboratory at Amsterdam, and the great authority on this kind of infestation, who was good enough to examine the Eelworms, and pronounce them to be without doubt *Tylenchus devastatrix*.

At p. 45, in the foregoing pages, will be found a few lines of description of this Nematode and its life-history; and at p. 47 a figure of distorted growth at the base of the stem of a Tulip-rooted Oat plant caused by the same species of Eelworm, which gives an idea of the growth sometimes to be found round the Eelworm-sick bulb.

The Plate* opposite gives figures of *T. devastatrix*, including male and female Eelworms taken from Onions, in each case magnified 200 times; and also the anterior portion of another of the same species, also taken from an Onion, and magnified 440 times. The figures are copied from the work mentioned below by kind permission of Dr. Ritzema Bos,† with his explanations as below.

In reply to my enquiries, Mr. Pratt kindly furnished me with some observations pointing strongly to this infestation being propagated or spread, just in the same manner with the Onions that it is with Oats or Clover, by infested plants being thrown to the manure heap, from which the Eelworms are carried back to the garden ground or field. And besides this (with Onions), seed from infested plants may very

* Explanation of Plate.—Fig. 1. *Tylenchus devastatrix*, female, taken from an Onion plant; magnified 200 times.

a, spear; *b*, first muscular swelling of the œsophagus; *c*, second œsophageal ring; *d*, *e*, intestine, properly so called; *e*, *f*, rectum; *f*, anal opening; *g*, excretory pore (orifice of the lateral vessel); *h*, commencement of the ovary; *i*, ovule, with nuclei (or germs), not fertilised; *k*, first half of the oviduct (tube), with spermatozoids; *l*, second half of the oviduct, with glands in the wall; *m*, anterior portion of the uterus, containing a fertilised egg; *n*, sac, with closed extremity, second portion of uterus; *o*, vulva.

Fig. 2. *Tylenchus devastatrix*, male, taken from an Onion plant; magnified 200 times.

For *a*, *b*, *c*, *d*, *e*, and *g*, see explanation of preceding figure; *f*, cloacal opening; *h*, commencement of the testis; *i*, mother-cells of the spermatozoids (Spermatoblastes); *k*, cells further divided, forming spermatozoids; *l*, vas deferens; *m*, spicule; *n*, accessory piece; *o*, purse.

Fig. 3. Anterior portion of a *Tylenchus devastatrix*, not fully developed, taken from an Onion plant; magnified 440 times.

For *a*, *b*, *c*, and *d*, see explanation of fig. 1. In front of the spear (*a*) is shown the labial region, and lower, at the base of the spear, the *musculi protractorii* leading forwards, and the *musculi retractorii* leading backwards. The half of the œsophagus in advance of the first bulb, or muscular swelling (*b*), has a straight direction; the half which extends from the first to the second muscular swelling is waved. In the second bulb nuclei are visible. Near (*d*) the intestine begins; in the wall of this the separate cells are not distinguishable, because of the presence of the numerous drops, which refract the light strongly.

Fig. 4. Anterior portion of a *Tylenchus devastatrix*, taken from a Wheat plant; magnified 440 times.

Fig. 5. Eelworms from Hyacinth, dried and rolled together.

Figs. 6 and 7. Eggs of *T. devastatrix*, showing an early and late stage of formation of the embryo.

Fig. 8. The young wormlet (*T. devastatrix*) newly emerged from the egg.

Fig. 9. Egg of *T. devastatrix* before segmentation of protoplasm.

The figures on the Plate are all greatly magnified. The life size of the male and female is 1·5 mm., that is, a little more than the twenty-fifth part of an inch.

† See Plates I. and II. in 'L'Anguillule de la Tige (*Tylenchus devastatrix*, Kuhn),' par Dr. J. Ritzema Bos, Professeur à l'Institut Agricole de l'État à Wageningen (now Director of the Phytopathological Laboratory at Amsterdam).

likely infest the land anew. Likewise, in garden ground, it may very possibly happen that the infestation may be started by diseased Hyacinth-bulbs being thrown to the decay heap; these are very subject to the "ring sickness," as it is called in Holland, caused, like that of Onions, by *T. devastatrix*.

On June 11th Mr. Pratt wrote me :—

"Now as to the questions in your letter and suggestions. In my ignorance I have allowed infested bulbs to be thrown on manure and rubbish heaps. . . . I always grow a good many Hyacinths, and the bulbs, after flowering, have been thrown to manure or rubbish heaps, so that, if any were slightly infested, the arrival of the pest is accounted for."

Mr. Pratt further remarked that six years ago he left his former residence, and "brought," he wrote, "with me to this place a quantity of Onions, partly to raise seed and partly for use. The bad bulbs were again thrown to the manure heap, and *so* my new garden became infested, and wherever I sow Onions, the pest appears. I, of course, never sow any crop on the same ground two years consecutively."

But with regard to precise detail of *starting* of the infestation Mr. Pratt favoured me with the following very practical note :—

"When I came to my present home, my new garden was manured entirely with manure brought from an hotel stable, which had not been mixed with any rubbish in the way of diseased Onions. In that year my Onion crop was perfectly sound; no sign of Eelworm. That same winter the garden was manured with manure brought from my former home, *well* mixed with diseased Onions as usual. The next season my Onion crop was badly affected, and has been ever since."

In reply to some of my remarks as to the disease being propagated by seed from infested Onion plants, Mr. Pratt mentioned that for many years he had always used seed of his own saving, but for two years he had used seed bought from seedsmen.

The above observations give a very sound and noteworthy account of how, when once the disease is set up, it is continued by the manure infested with Eelworms from the diseased Onions mixed with it being spread upon the ground; also how, when *uninfested manure* was used in one year to the *fresh uninfested ground*, there was *no* attack, but with the application of the infested manure in the following season, the disease showed itself.

Where attack is bad, that is, where there are many Eelworms in the Onion, it dies off; but where there is only a moderate quantity, the bulb may grow on, possibly to nearly full size, but almost certainly will show the presence of the disease by the outer coats of the Onion, which are abnormally thickened, being cracked open and pushed aside by the pressing forward of the also enlarged inner growth.

At p. 107 is a figure, not quite life size, of an infested Onion, photographed from a specimen grown in my own garden. If the reader will examine this with a magnifying-glass he will notice the unnatural thickening of the coats, and that these have gradually been pushed open and back until the edges of the quite outside scales are as much as a third of the width of the Onion apart, and those of the next inner ones half to three-quarters of an inch apart.

In the figure given below, also taken from a photograph of an Eelworm-diseased bulb grown in my own garden, the same cracking and pressing off of the outer coats will be noticed, especially on the

Eelworm-sick Onion, showing diseased growth.

right side of the bulb, where four or five outer coats (the three uppermost dead and shrivelled) will be seen to have been pressed off by the much swelled development of the part of the bulb immediately beneath.

The reason of this cracking open is given as follows by Dr. Ritzema Bos * in his admirable paper on this infestation :—

"As in the case of this disease in Rye, the reason of the abnormal appearance of the plants similarly results from the fact that the growth in length of the fibro-vascular bundles is arrested by the presence of the Eelworms, whilst, on the contrary, the parenchyma of the leaves assumes abnormally enlarged proportions. From this it results that the plants remain short, swell, and shrivel" [or twist,

* See 'L'Anguillule de la Tige (*Tylenchus devastatrix*), et les maladies des plantes dues à ce nématode,' par Dr. J. Ritzema Bos, I. p. 130, Haarlem.

"se crispent," Ed.], "and the scales acquire an extraordinary size. At the part where the Eelworms are to be found in great numbers, the leaf or the scale shows the greatest thickness; this is not the same everywhere." *—(J. R. B.)

The bulbs figured were lifted (as well as other Eelworm-sick specimens) from one of the Onion beds in my garden in the middle of July; the one figured at p. 107 was about three and a quarter inches across by a little more than two inches high. On taking one of the thickened diseased outer scales from this bulb, I found that the skin on the inner side of the scale peeled away in a film at a touch, and between this and the skin of the outer side the substance of the scale was decomposed, or, perhaps I should say, disintegrated, into a mere collection of cells, to a great extent separated from each other. This mass was dead, but not yet decayed, and in it I found some Eelworms; but in a scale underneath it, in which some life was still remaining, I found Eelworms of all ages, absolutely swarming, and their eggs also in great numbers.

In both of these nearly-grown Onions, which I carefully examined, I found yellow crumbly matter under the edge of the swelled cracked-back scales, or near the base of the bulbs, just such as we find inside the hollow parts of "Tulip-rooted" Oats or of "Stem-sick" Clover.

Having been able to observe the shortened swelled growth of the young growing plants, and also the widened growth of the diseased bulbs with their thickened scales cracked open by the enlarged growth of the inner ones splitting the outer ones aside to make room for them, I was desirous to see also the appearance of the commencement of disease, when beginning at the very germination of the seed. The process of this (see work by Dr. Ritzema Bos, previously cited, p. 129) is that when, in germination, the spermoderm (skin of the seed) breaks open, then the Eelworms, which are in the soil, obtain entrance into the cotyledon (the first leaf of the germinating plant) almost before it has sprouted. Consequently on this attack, the cotyledon at once assumes a deformed growth, such as swelling in different parts, or with unnatural bends; also whilst in the case of the little seedling Onion sprouting naturally, the cotyledon usually carries the empty seed husk on its top, in the case of the infested seedlings this cotyledon or seed-leaf may be so much swelled that the seed-husk is detached, and the young plant comes through the soil without it.

On September 5th, in order to watch this myself, I got my gardener to fairly fill a flower-pot, ten inches across, with earth, on which we

* Without entering on elaborate botanical explanation, it may be of use to mention that parenchyma is the term given where the cells of the tissue are roundish or elliptical; whilst the fibro-vascular bundles consist of woody tissue, and spiral or much elongated vessels.

strewed pieces of an infested Onion, and on this we sowed Onion seed, and then scattered the right depth of soil. In due time a moderate amount of the seed germinated, and (as above noted is the case with infested seedlings) scarcely any of the young sprouting plants carried the seed husk on the top, and I observed that the abnormal twisting or bending was very noticeable,—in the words of my gardener, "the tops were twisting and curling all over the top of the pot."

From the melancholy reason alluded to in my Preface, I was not able to give the full attention to my experiment which I should have wished under other circumstances, and I did not examine into the reason of the gradual dying or disappearance of the young plants. But at the end of December I noticed that one little plant was still alive. This was about one inch long, and somewhat thickened at intervals; and I cut it into three lengths, and examined these microscopically by tearing or "teazing" the tissues out with water on a slide. In the middle and in one end length I did not find any Eelworms, but in the other piece I found several of various ages,—one or two apparently quite full grown, the others varying in size down to, approximately, an eighth of the length of the largest specimen. The parenchyma (or roundish cells of the leaf) were also more separated in this piece than in the rest of the plant.

Thus we secured all the links of the chain of the life-history of the infestation in the Onion, besides having an example of the manner in which the disease is propagated by passage of Eelworms out of infested ground into germinating seedlings. We had the grown Onions cracking open from the pressure of the swelled inner scales, noticeably swarming with Eelworms, and going on to destruction by decay; then by sowing pieces of the infested Onion with common Onion seed in earth, in the usual manner, we produced a crop of seedlings twisted all about, and without their seed husks on their tops; and on examining within, I found the Eelworms present and alive on December 30th.

The stage of disease in the growing plant as shown when about six inches high, I had plentiful specimens of from Ashby-de-la-Zouch, in which the shortened and widened and also puffed or inflated growth, which is characteristic of the Eelworm presence, was very noticeable.

The attack is considered to be worst to the Onions in their earliest life, when, if there are many of the Eelworms in one little plant, it will probably entirely fail under their workings. After what may be called middle age, the plants suffer less, but still are susceptible of attack; and in all stages the infested plants are liable to rapid decay.

Prevention and Remedies.—One point is carefully destroying all infested Onions. These should be raised (not merely attempted to be

drawn by hand) and burnt. If thrown to the manure heap, as men-at p. 110, the wormlets will live on, and they, or their descendants, will be presently distributed in the manure, and infest anything liable to their attacks,—those bred in Onions being observed to have especial preference for again choosing Onions for their attacks.

Resowing on ground which has been infested is obviously to be avoided; likewise care should be taken that none of the earth from beds where there has been presence of Onion Eelworm-sickness should be carried to other parts of the garden. Even a small quantity of this infested soil, such as may cling to the workmen's boots or to gardening tools, as forks or spades, or to the wheel of a wheelbarrow, is quite enough to start presence of the pests.

Where trenching can be managed without loss from turning up a barren subsoil, this is a good plan, as it buries down the Eelworms out of the way. Digging, or even double digging, only destroys some amount of them, and scatters the rest harmlessly (to them); but true trenching, in which the upper "spit" (or spade's depth) is buried down, and the next "spit" beneath brought to the surface, is a very effectual way of getting rid of this and many other infestations.

Probably growing Onions in succession to Celery would answer well. The thoroughly deep stirring of the soil in forming the trenches, and the rich, well-cultivated state of the ground, would respectively be very good for getting rid of the Eelworms, and also for encouraging the good hearty growth of the Onions, which enables the plants to resist attack, if not absolutely overwhelming. On the above principle good manuring is recommended.

The recipe for destroying the Eelworms in the infested seed, without injuring the power of germination, is steeping the seed at sowing-time for twenty-four hours in a very weak mixture of sulphuric acid and water. The acid used should be the ordinary English commercial acid, not the coarse dark brown kind, and the proportion, as near as may be, one pint of acid to a hundred and fifty quarts of water. *But great care* should be taken both that this dangerous acid (popularly known as vitriol or oil of vitriol) should be carefully secured in a well-marked bottle, and kept under lock and key, so as to avoid all risk of accidents; and also in mixing it, it should be remembered that in certain proportions great heat is generated, sufficient to break a glass, or, by some of the mixture flying, cause dangerous accidents. Adding the *small proportion of acid named to the water* is quite safe, but before adding small quantities of *water to the acid* (or other uncertain methods of action) advice should be taken.

As yet we do not hear of this attack, which is so destructive in some of the Onion-growing districts in Holland, having appeared in our own fields, but even on this broad scale the above principles are

applicable, namely, burning diseased plants, only sowing good seed, or steeping what may be infested, and substituting crops not liable to Eelworm infestation for a time. As above mentioned, good manuring to help the plants over moderate attack is also important.

How the attack came into my own garden I am wholly unable to say. I did not see a sign of it in the bed with my crop of summer Onions; nor in the rows of seedlings sown in autumn for next year's supply could I say that there was a trace amongst the thousands of plants, all these being (so far as I am aware) *entirely* sown from the same bag of seed. I found the disease only on the one patch named, and in seedling Onions raised in earth mixed with pieces of infested Onion from this patch. My only explanation is that, as I am frequently in receipt of specimens of Tulip-rooted Oats and Stem-sick Clover, by accident some of the specimens, instead of being carefully destroyed, were thrown aside in the garden, and that thus the Eelworms (*T. devastatrix*) within made good an establishment.

The above notes give some idea of the characteristics and serious nature of Onion-sickness, that is, of Eelworm attack in connection with Onions, for which (excepting such matters as I have myself become acquainted with in the course of the past year) I am indebted to the excellent articles of Dr. Ritzema Bos, given in his 'Anguillule de la Tige,' and more recently still in his 'Tierische Schadlinge und Nutzlinge.'

For descriptions and means of prevention of attack of the same species of Eelworm, namely, *Tylenchus devastatrix*, in connection with Oats and Clover, the reader is referred to the preceding paper on "Stem Eelworms," at pp. 44–52.

Should any readers have doubts whether their Onions are suffering from this attack, or should desire more detailed information, I would gladly examine microscopically, and give my best attention. Only, as decaying Onions trench a little on what is admissible for postal transmission, I would beg them not to send more samples than necessary, and to secure them by safe wrapping or packing in a tin.

PEAR.

Pear Gnat Midge. *Diplosis pyrivora*, Riley; *Cecidomyia nigra*, Meigen and Schmidberger; *C. pyricola*, Nordlinger.*

The Pear Gnat Midge is a very frequent trouble to Pear growers from the damage caused by its little legless, yellowish white maggots living in numbers inside the young Pears in their very early condition. Consequently on the maggots feeding within, the growth of the young Pears is checked and stunted, the centre decays, and the fruit cracks or dies, and drops off.

This attack was first reported to me in 1883, with good specimens of Pears with their growth aborted by the infestation sent accompanying, respectively from one of Lord Walsingham's farms in Norfolk, and from near New Quay, Cardiganshire, South Wales, the two localities being on the extreme east and west of this island, somewhat suggesting that the Pear trouble, if known by sight, might have been observable in the country.

At that time, however, the attack had been so little noticed that Prof. C. V. Riley,† Entomologist of the U.S.A. Department of Agriculture, mentioned the above observations as the first time attention had been called to it in England. It must, however, have been present in this country for several years previously, as in 1874, or 1875, the well-known entomologist, Edward Newman, received Pears affected by this attack from Mr. Hy. Reeks, of Thruxton, which were sent on by him to Mr. E. A. Fitch. I do not, however, find that anything regarding these specimens was published.

Since then (1883) the attack has become one of our regularly recognized infestations practically; but so much discussion arose consequently on its much increased area of distribution here and in the United States of America as to the precise scientific name under which it might rightly be described, that I postponed bringing the observations forward. Now, however, and for some years back, it has been agreed, consequently on the investigations of our own well-known dipterist, Mr. R. H. Meade, and also those of Prof. C. V. Riley, that the previous names of *Cecidomyia nigra*, of Meigen and Schmidberger,

* I have not had opportunity of figuring this species, but the various figures of Cecidomyiæ, in gnat and maggot state, given in various of my Reports and my 'Manual,' will convey a very fair idea of the appearance when magnified, and also natural size.

† See 'Insect Life,' Periodical Bulletin of the U.S.A. Department of Agriculture, vol. i., No. 4, p. 120.

under which it was formerly known on the Continent of Europe, and that of *C. pyricola*, of Nordlinger, should be dropped, and that of *Diplosis pyrivora*, Riley, adopted as the accepted designation. Still more recently, a great deal of information has been gained on the much more important matter of how to deal practically with the pest, therefore, as the notes sent me in 1896 show it is still at work, some further observations may be of interest.

The "Midge" which causes the mischief is a very small two-winged gnat-like fly, only about one line (the twelfth of an inch) or a little more in length of body; the general appearance greyish or black. More in detail, when seen much magnified, and as described by Mr. Meade from his own very complete observations, the head is black, with a patch of yellow hairs, on the top of which some come forward over the eyes. Antennæ (horns) yellowish brown, in the male about one-fifth longer than the whole length of the insect, in the female about two-thirds of the length without the oviduct. Thorax (body between the wings) black, and, like the face, with grey reflections; and seen "from before, the hind part looks ash-grey, while the front part appears divided into three wide black stripes or patches, of which the middle one is triangular in shape, with a broad base in front, and tapering to a point behind where it joins the scutellum." On each side between the central and side black patches is a row of bright yellow hairs; but "viewed from behind, the whole thorax looks grey." A long tuft of yellow hairs is placed above and in front of the root of each of the wings, and the front edge of the thorax is covered with short yellowish hairs. Abdomen dark brown, clothed with long whitish hairs. Halteres (poisers) with yellowish stalks, and clear white knobs. Wings dusky, clothed and deeply fringed on the hind margins with black hair. Legs brown, clothed with white hairs, more dense on the under surface.*

Wing of *D. pyrivora*, magnified.

I have never seen deposit of the eggs myself, but the method of operation is stated to be when the Pear blossom-buds are so far advanced as for a single petal to show itself, for the Pear Midges to deposit their eggs within by piercing the petal with the ovipositor, and laying their white longish eggs, up to as many as ten or twelve in number, on the anthers within the still unopened blossom-bud. They were also seen by Schmidberger, the chief authority on method of egg-laying, to pierce the outside of the blossom with the ovipositor.

* For full and very clear description of the imago or perfect Gnat Midge of the *D. pyrivora*, from which I have, with many thanks, extracted the above few points, see paper on "*Diplosis pyrivora*," by R. H. Meade, in 'The Entomologist,' vol. xxi. pp. 123–136. London: Simpkin & Co. 1888.

The eggs are stated to be so quickly hatched in warm weather, that the little maggots from them may be found on the fourth day after deposit. They bore into the core of the embryo Pear, where they separate and devour in different directions.

The maggots are about one-sixth of an inch in length, narrow, legless, smallest at the head and tail, with a small horny appendage, known as the breast-bone, or (from its form in some of the Cecidomyiæ larvæ) as the "anchor process," beneath the fore part of the body near the head end. In the Pear Gnat maggot this process consists of a narrow stalk attached at its base to one of the segments of the little larva, and pointing forward at the free end, which is enlarged to nearly twice the width of the stem, and slightly notched at the flattened or convex end. The anchor process is of a horny texture, and brownish or pink in colour.

The maggots have a wonderful power of jumping by bending so that head and tail meet, and then taking skips in all directions, a habit which is very observable if they chance to be under examination on a coloured tablecloth.

Within the young Pears, the growing *Cecidomyia* maggots live and feed till they have attained their full size. This will be somewhere about the beginning or middle of June, by which time much of the inside of the little Pears will have become black and decayed, consequently on their ravages, and the fruit stunted in growth, and probably cracked. The infested Pears may often be known by their knobbed irregular growth, but not always; some that I have had, have not shown characteristic damage outside; also the size that they may grow to varies. In the eight figures now before me, given in the paper by Prof. John B. Smith * on this infestation, none of the Pears are as much as an inch long, but they may reach as much as one or two inches in length.

At this stage the Pears crack or fall to the ground, and the maggots leave the fruit by way of the open cracks if it remains on the tree, or if it falls without cracking, may remain for some weeks within. In either case they bury themselves in the ground, and (quoting again from Prof. J. B. Smith as, I believe, our most recent observer) go down to a depth "varying somewhat with the condition of the soil, from one-half to two inches, and there they lie for some time unchanged. About midsummer the larvæ make oval cocoons of silk covered with grains of sand, and in these they lie unchanged until early spring."—(J. B. S.) There appears to be a difference in date of time of the maggots forming cocoons, and turning to pupal or

* See 'The Pear Midge, *Diplosis pyrivora*, Riley,' by John B. Smith, Entomologist, New Jersey Agricultural College Experiment Station, U.S.A., Bulletin 99, April 4th, 1894.

chrysalis state within them, possibly from not being in quite natural circumstances; but in regular course, whatever the exact date of pupation may be, the Gnat Midges come up out of the ground in spring ready to attack the blossom-buds of the Pear.

The kind of Pear which has been particularly observed as being subject to this attack is the Marie Louise. I have also received report of it as having "destroyed a fine crop of Beaune Bachelier Pears." In the past year (1896) the name of the kind of Pear of which infested specimens were sent me was not mentioned.

Prevention and Remedies.—For *preventive* measures I do not see that any are more available than those that I suggested in my previous observations. These were, in cases where the crop is in reach, to pick off and destroy (not merely throw aside) the little stunted Pears, and also to pick up, as soon as possible, and destroy the small fallen fruit. To this, probably the treatment of giving a thoroughly good shaking and jarring of the boughs of the infested tree, so as to shake down as much of the infested fruit as possible, *as soon as possible*, would probably be a very serviceable addition. Also if previously tarred cloth or any rough cheap material was spread under the boughs of the tree, so that the infested fruit and the maggots which escaped from it might all be gathered up together and burnt, or well shaken out together into a hole and well covered down, this would save much escape of the maggots. Also spreading a coat of quick-lime on a *dry day* beneath the infested tree, and then slaking it, might have a very good effect, and the lime would kill many of the escaping maggots.

Where Pears are grown in grass orchards, a deal of the fallen infested fruit would be cleared off by having sheep on the ground; and where the ground below the trees is free of crop, and the Pear roots not too near the surface, the plan of skimming the surface and destroying the surface earth with its contained infestation would answer well.

The depths given for presence of the cocoons are half an inch to two inches, and this might (I believe) often be safely removed; but I would on no account whatever advise the treatment which I see at times recommended in this country with regard to clearing infestation from soil under trees or fruit bushes, namely, that of *digging the ground*. Such treatment is absolute destruction to the surface roots, a large proportion of which lie much nearer the surface of the earth than a spade's depth; and also, although some of the cocoons may be buried down so as to be put out of the way of doing mischief, yet a large proportion are only scattered about in the soil, and the insects develop from them as safely as I have known them to do where the

infested skimmings from under Gooseberry bushes were laid in rows between the rows of plants.

It should perhaps be noted with regard to this attack that the only connection it has with the Pear tree is with the blossom-buds for the purposes of egg-laying, and with the young fruit, in which the maggots feed until, at their maturity, they quit the fruit, and bury themselves in the ground to go through their changes to the complete Gnat Midge. Therefore the washings, or lime dustings, or scrapings of the trunk of the tree, which are so very serviceable in cases of various other Pear or Apple attacks (notably that of Codlin Moth) are of *no use at all* with this infestation.

In the observations sent me on May 25th by a correspondent, of a bad attack of the Midge maggots on his young Pears at Carnforth, Lancashire, he mentioned that he had dusted the trees with lime, and also sprayed with Paris-green, without any good effects; but relatively to the latter application, it has been suggested that where attack is very bad indeed, so as almost certainly to involve losing all the young Pears, that it might be worth while to spray so strongly with Paris-green, or some other arsenite, as to blast the fruit, and thus prevent the contained maggots coming to maturity and continuing the attack. This would be a point for consideration of the grower.

The best remedy of which we have information at present appears to be (as reported by Prof. J. B. Smith) application of kainite to infested ground. In an observation on infested Pear orchard land at New Brunswick (U.S.A.), a heavy top-dressing of kainite was applied in late summer, and under the infested trees it was applied at the rate of over half a ton per acre. The result was that in the following year scarcely any of the fruit was found to be infested, whilst in another orchard close adjoining, in which the ground had not been treated, on close examination, it was found that of one kind especially grown fifty per cent. were "midged," and of the other kind named not one could be found to have escaped. (See Bulletin previously referred to.)

In laboratory experiment Prof. Smith found that where nitrate of soda was sprinkled in quantity that would represent a fair top-dressing in ordinary field use, on sand in which maggots had gone down, that not ten per cent. of the larvæ were alive (so far as examined) in their cocoons, and where a double quantity of the nitrate was applied, a still lesser proportion of the maggots was found to be alive.

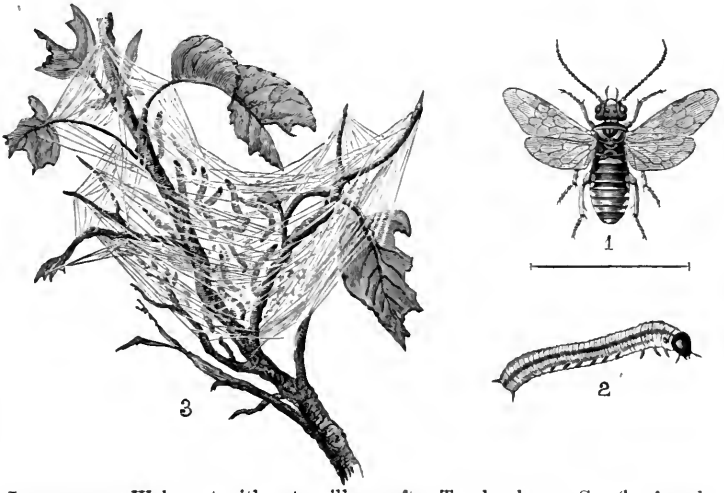
Muriate of potash in about the same quantities showed results of respectively nearly one-half or three-quarters of the maggots dead in their cocoons.

But in the case of treating with a small quantity of kainite, only three per cent. of living larvæ were found in the cocoons examined; and where double quantity was used, "not one-third of the larvæ in

the jar had ever formed cocoons, and those that did seemed all of them to be dead."—(J. B. S.)

The experiment is given in minute detail in the Bulletin previously referred to, the period from commencement to final examination ranging from June 10th to October 6th, and I believe may be of great assistance to us in checking attack of this destructive "Gnat Midge."

Pear Lyda; Social Pear Sawfly. *Lyda pyri*, Schrank; *L. clypeata*, Klug; *L. fasciata*, Curtis and Westwood; *Pamphilius flaviventris*, Cameron.



LYDA PYRI.—Web-nest with caterpillars, after Taschenberg; Sawfly, female, magnified, and larva, full size, after Cameron.

The Pear Lyda, or Social or Web-spinning Pear Sawfly, as this species is variously named, is, so far as I am aware, not at all a common infestation in this country. I have never had specimens sent me until the past season; and in Prof. Westwood's paper on this species, from his own observations made in his garden at Hammersmith,* he mentions his great pleasure in discovering "that one of the rarest British species of the genus" may be obtained in suburban gardens. Mr. Cameron notes it as "probably common in gardens in England," but that he has not found it in Scotland; and looking at the bright shiny orange colour of the many caterpillars feeding together in a web several inches in diameter, and the devastation to the spun-up leafage, the attack is one to attract so much attention from the most unobservant, that it is to be hoped it is not very often present.

* See 'Gardeners' Chronicle' for 1851, No. for January 18th, p. 36.

On June 25th in the past season I was favoured by Mr. Colvile Browne, of 2, Plantation Cottages, Hextable, Kent, with an excellent specimen of a web-nest and its tenants, accompanied by the following remarks:—

"Can you name the enclosed for me? As you see, it is on a Pear shoot. I found a batch on the same row of trees last year, and this season only one. Last season's batch were older, and of a bright orange colour; they would *not* feed in confinement, but lived about three months without appearing to feed, and then gradually shrunk to very small dimensions. I have not found this insect on any other tree in the locality."—(C. B.)

The caterpillars sent proved, both in appearance and habits, to agree excellently with the description of the kind which is still perhaps most frequently known by its old name of *Lyda pyri*, or the Social Pear Sawfly. They were as yet (as noted by Mr. Colvile Brown) not full grown, being hardly half an inch long, the full length being three-quarters or nearly an inch. The colour of the caterpillars reddish or reddish orange; they are very smooth and shining, and somewhat cylindrical. The head very shining black, with a pair of pointed antennæ, ringed black with a little white; rings apparently about seven,* but difficult to count with certainty. On the segment behind the head were some small black markings. The three pairs of claw-feet were of the orange colour of the body, and there were no ventral or sucker-feet; but on each side of the terminal segment was a pale antenna-like process (see figure of larva, p. 121), each about as long as the space across the top of the segment between the lowest joints of this pair of horn-like processes, which pointed slightly backwards. There was some variety in colour in the caterpillars, according to whether they had been lately feeding; in this case the devoured matter from the Pear-leaves gave a greenish tint through the transparent skin. My specimens were obviously only about half-grown; but (as noted by Prof. Westwood in account referred to) this kind does not, like many Sawfly larvæ, change colour at different ages, but young and old are similarly coloured.

The web-nest, in which the caterpillars lay, was three inches long, formed of threads spun from their mouths to the Pear-leaves on which they were feeding, and when received (very likely a good deal injured in transit) was an irregular piece of webbing about three-quarters of an inch less or more in width. The earliest spun part, which was black with decay and dirt of various kinds, was deserted, and the caterpillars lay for the most part in two clusters, one of about twenty-two or more grubs, one of not so many. These were closely packed

* Mr. Cameron says, "with long seven- to eight-jointed antennæ" ('British Phytophagous Hymenoptera,' vol. i. p. 53).

together in their web, but reached out from it to feed on the Pear-leaves, which they greedily devoured, starting at the edge, and made great havoc with. In one instance they had eaten away about two-thirds of a leaf up to the mid-rib, leaving only part of some of the chief side veins.

The spinning powers of the caterpillars were very noticeable in endeavouring to reconstruct a shelter for themselves when a Pear-leaf, which had partly covered over a large party of them, had been removed.

On July 21st Mrs. McQuoid, a friend and neighbour, mentioned to me having observed a web-nest, estimated at about three inches across, on a Pear tree in her garden in Romelands, St. Albans. This contained about fifty shining, reddish orange, "worm-like" caterpillars, which were doing so much damage that the nest had been cut off and destroyed before I heard of it; but from the description (though without personal inspection) I do not think it could be other than one of the social collections of caterpillars of *Lyda pyri*.

I have not had the opportunity of tracing the whole life-history of this Pear Lyda, but taking the main points from the writings of the late Prof. Westwood, Schmidberger, and Taschenberg, it is as follows.

The female Sawfly lays (towards the end of May) from forty to sixty eggs, mostly on the under side of the Pear-leaves. These eggs are longish in shape, yellow, and look as if smeared with grease, and are laid with great regularity in rows. The caterpillars, which hatch out in a few days, are at first of a whitish yellow colour, but become darker after the first moult, and begin immediately to spin a loose web, in the threads of which they climb to and fro. This web is enlarged, as requisite consequently on the ragged and filthy condition which it acquires, or to enlarge the feeding-ground, and the caterpillars drag themselves about within it by holding on to the threads, and in four or five weeks attain their full growth.

They then let themselves down to the ground, and bury themselves as much (it is said) as four inches deep, or deeper still, in the earth, in a smoothed cavity, but without spinning a cocoon. Here they change to the perfect Sawfly, which, according to recorded observations, may appear in the following spring, or in the spring next but one to date of going into the ground.

Various observers have mentioned difficulty in rearing this Sawfly in artificial circumstances, and perhaps the following plan, which I have found answer well, though I have not tried it with this special infestation, might help those who wish to observe the life-history of this somewhat rare attack. I took a wire or pierced metal dish-cover, such as is used for preventing flies getting at meat in larders, and placed this on the ground where the larvæ had buried themselves of

which I wished to secure the perfect insects. Thus the grubs were left undisturbed in perfectly natural circumstances, and all that was necessary was to look frequently when the time of development drew near, lest, in case of Lepidoptera (*i. e.* butterflies or moths), the specimens should have had time to injure their plumage by beating on the metal cover. With specimens of this nature it is well to have a few twigs firmly set in the ground under the dish-cover for the newly-developed insects to crawl up and rest on whilst spreading their embryo wings to full size.

Returning to the Pear Lyda. The figure at p. 121 shows the form of the fly and the neuration of the two pairs of wings. The fly is four to five lines in length of body, that is, from a third of an inch to rather more; the expanse of the wings somewhat under an inch; the colour chiefly black, but the abdomen tawny towards the extremity, with a triangular yellow mark in each segment; ventral segments banded with yellow. The base of the antennæ and also the legs yellow; the four hindermost of the thighs black at base. Wings hyaline, with a broad smoky band below the stigma.*

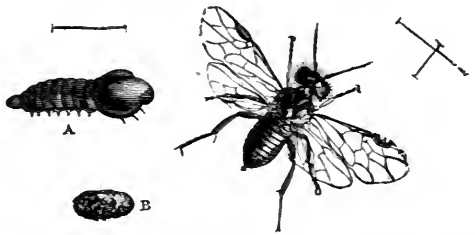
Prevention and Remedies.—The simplest and most effectual plan would be, wherever the webs are in reach, to cut them off and destroy them with their contents. But a little care must be taken in order to secure all the caterpillars, as on alarm, when nearly full grown, they may let themselves down by their threads, and so escape into the ground. This might easily be prevented by holding a pail below the nest with some sticky fluid in it, soft-soap wash for instance, which would effectually prevent stray caterpillars getting away; and indeed the best method of operation would be to cut the nest itself and its contents off into the pail of soft-soap wash, aud thus make quite sure of none escaping.

Where the nests are out of reach, syringing soft-soap or soft-soap and paraffin wash at them, so as to sodden the web, would be good treatment, taking care, as before mentioned, to have something placed below to secure such caterpillars as might let themselves down.

This infestation is known as that of the *Pear* Sawfly, but it is also mischievous to the leafage of Plum and Cherry trees, and likewise to that of Whitethorn.

* For description of fly (*imago*) see 'British Phytophagous Hymenoptera,' by P. Cameron, vol. iii. p. 97; and for figure of fly, vol. ii. of same work, plate 6; and of larva, plate 12 of same volume. These figures I beg to acknowledge with thanks as having been copied in my own figure, p. 121.

Pear and Cherry Sawfly. *Selandria atra*, Stephens and Westwood; *Eriocampa limacina*, Cameron.



SELANDRIA ATRA.—Slugworm and Sawfly, magnified, with lines showing natural length; cocoon.

The small blackish moist-looking grubs, known as "slugworms" from their great resemblance to little slimy slugs, feeding on the upper surface of the infested leaves (and which, like the attack mentioned in the preceding pages, are the larvæ of a Sawfly) were more than usually reported in the past season.

These larvæ feed on the leaves of Pear, Cherry, Plum, and various other allied trees, and devour the skin of the upper side of the leaf, so that the remainder appears like a net-work of veins, held together by the skin of the lower side, which is left untouched, and turns to a deep brown colour.

The first notice I had of the attack in the past season was sent me on July 1st from the Estate Office, Maresfield Park, Uckfield, Sussex, by Mr. M. Sandford, as follows:—

"I send you by this post a box containing some nasty caterpillars that are infesting the Pear trees in the garden here; the men say they have never seen any before. They are on the outside of the leaf, not, as is usually the case, under the leaf; and they attack trees on the wall principally, commencing at the top and working downwards."—(M. S.)

Some of the specimens sent were just arriving at their last stage of growth as caterpillars, in which they moult off their black slug-like skin, and appear as yellow or buff-coloured caterpillars, free from all moisture, and wrinkled across instead of being smooth and slimy.

On July 8th Mrs. Besley, writing from Braunton, North Devon, observed:—

"I send by same post specimens of caterpillars that have been devastating some of the fruit trees in my garden, Cherry trees especially, a large one in one week was just a skeleton. They have also attacked Plum, Peach, and Pear; the latter standard as well as wall trees. No gardener in this village has seen the attack before; it appeared about the beginning of June. . . . Syringing with

Sunlight soap and water seems to do good, but not thoroughly destroy it."—(F. B.)

These specimens were also Pear and Cherry "slugworms."

On July 17th I had letters from Mr. A. H. Lowe and Mr. J. H. Lowe, of, respectively, Court of Hill, and Greenwayhead, Tenbury, Worcestershire, regarding a very bad attack which had stripped a large Pear tree almost completely of its leafage in four days from the date of first observation, the leaves dying and drying in the usual manner, from the skin of the upper side being eaten off. Specimens were forwarded, both of the slugworms and the destroyed leaves, with mention that there appeared to be two of the grubs on every leaf examined.

Shortly after (on July 25th) I had another communication from Mr. J. H. Lowe, in which he remarked:—

"I find they have done a great deal more damage than I was aware of among my orchards. I had put down a great deal of their depredations to the very long and extreme drought which we are having in this immediate district."—(J. H. L.)

This observation of Mr. J. H. Lowe's is well worth notice in connection with the remark made by Mr. Cameron (our chief writer on Sawflies*) as to weather influence on this infestation, "The damage done by these ugly brutes to fruit trees is very often immense; especially is this the case in very dry seasons." And also in the year 1893, amongst observations sent me by Mr. R. Cresswell Ward, on June 19th, of damage done by this maggot at Neasham Hill, near Darlington, he mentioned, "The heat is very intense; we all hope for rain."

I had also a note from Mr. Chas. S. Hughes (gardener), 8, Back Street, Chepstow, Mon., accompanying some infested leaves sent from off a Morello Cherry tree, with the observation that last year was the first in which the attack appeared. "It is on the tree again this year"; and "I see some of my neighbours are troubled with the same." The treatment applied had been use of Gishurst compound, and syringing with clean water. The specimens sent accompanying were in some instances full grown and black, and still covered with the sticky or slimy secretion, and others of them had turned to the yellowish tint which they acquire at the last moult.

It would not be of interest to give more reports, for no new information has been gained, so far as I am aware, since my notes given pp. 79–83 in my Annual Report for 1893, and everything we need to keep the attack in check is known; but though it was so prevalent last year, it seems to have been so rarely recognized, that a figure (p. 125) and a short description may be of use.

* See 'British Phytophagous Hymenoptera,' vol. i. p. 225.

The specimens of infested leafage sent me by Mr. Cresswell Ward, mentioned at p. 126, enabled me to watch the first part of the attack, which is so rarely recorded that I repeat it again.

In this case the active stage of the attack to some of the leaves sent me was only just beginning, the upper surface of the leaf not being as yet stripped of the cuticle in patches, but dotted with little irregularly circular patches, some less than half a line in diameter.

The places of egg deposit were very observable. These were noticeable on the upper side of the leaf as little spots, roundish in shape, and whitish in colour (from the upper coat of skin being dead), slightly raised in the middle, and of a somewhat transparent tint just over the contained egg, which was a soft mass, compressible, thick, and somewhat circular in outline.

Most of the larvæ had hatched out, leaving only the white skin cracked where the maggot had effected its escape, but two eggs still remained unhatched. One of these eggs contained the white Sawfly larva curled on itself within, and sufficiently developed to be of characteristic shape, that is, with the large segments behind the head, and the hinder portion of the maggot with the segments much narrower. In the other egg the contents were not yet sufficiently developed to be defined in shape. I did not see any larvæ in the act of coming out of the egg, but the smallest of them were as a general thing of a yellowish colour.

The little white blisters, or patches, of white dead skin covering the eggs were about one-sixteenth of an inch across, and on one leaf, where I counted them, over thirty in number; on another there were about twenty-five; all these (with possibly one exception) showing on the upper surface of the leaf.*

Shortly after hatching, the grubs become covered with a blackish or dark greenish secretion, from which, and their lumpy shape (see figure, p. 125) they receive their name of slugworm. When carefully examined, they will be found to be much the thickest at the fore part of the body, and to have twenty-two pairs of feet, that is, three pairs of claw-feet on the three segments next the head, none on the fourth segment, and all the rest of the segments furnished with a pair of sucker-feet. The pair on the terminal segment are, however, so small that sometimes they have been overlooked, or not considered to exist, and the larva classed as twenty-footed.

When full-grown, which is in five or six weeks, the slugworms are about five-eighths or half an inch long, and they then cast their bottle-green smooth coats, and appear as buff caterpillars, dry and free from all slime or shininess, and, instead of being smooth, transversely wrinkled. After this the caterpillars go down into the ground, where

* See 'Seventeenth Report on Injurious Insects,' by E. A. Ormerod, p. 81.

they spin an oval dark-coloured or black cocoon, from which the Sawflies come out in the following summer. The earliest date at which I am aware of having received attack is June 14th.

The flies (see figure, p. 125, for shape and size) are shining black; antennæ rather longer than thorax; legs black or fuscous, the front ones somewhat lighter at the lower parts; wings stated to be "rather deep fuscous, with the apex pale; nervures and costa black; stigma brown, and in the second submarginal areolet a small fuscous cloud." I am not able to describe the flies from life myself, as, though the "slugworms" are sent in quantities, I have rarely had the Sawflies, and the differences in description of colour of the legs given by different entomologists, even where it is absolutely certain it is the same species which they are describing, are suggestive that the colouring is variable.

Prevention and Remedies.—These consist in shaking down the Sawflies when they are resting or egg-laying on the leaves, taking care that they shall fall on tarred cloths, or some means be taken to prevent their escape.

Skimming the surface of the soil during winter, and destroying this with the contained cocoons; and (to destroy the slugworms) syringing with any trustworthy insecticide, or thorough good dustings with some caustic powder, which will kill the grubs. Lime is said to answer well; but I have had perfect success with dusting well with a mixture of soot and lime. So far as I saw, not a "slug" survived, and a good syringing down with water the following day cleans the powder off the leafage. If only a slight dusting is given, the slugworm can moult it off, and to do any good the dressing must be very soon repeated; but my gardener did the work so thoroughly that there has been no trouble since.

Recipes for all the above methods of treatment will be found in the preceding pages, by reference to the Index.

"Oblong Leaf Weevil;" "Downy-brown Leaf Weevil."

Phyllobius oblongus, Linn.; *P.* (*Nemoicus*) *oblongus*, Stephens.

The "narrow-bodied" brown Leaf Weevil, scientifically *Phyllobius oblongus*, is a common kind in this country, and is known on the Continent as being at times very destructive. But here it is not so much noticed as the bright green kinds of *Phyllobius*, the genus to which it belongs, which sometimes, as in May, 1888, do damage over hundreds of acres by devouring the leafage of orchard trees, as of Apples, Plums, Cherries, Nuts, &c.

These beetles are nearly allied to the *Otiorhynchus* weevils, and the figure under this head in my previous Reports and 'Manual' will give some general idea of their structure; but they (the *P. oblongus*) are very small, only about the sixth of an inch or a little more in length, and more elongate or parallel-sided in shape. The head and thorax are usually black; the wing-cases variable in colour, pale dull red or brown, with the margins often black, or sometimes they may be entirely pale,—my own specimens, from Kent, have been with reddish wing-cases and black borders, also I have them with reddish brown, and yellower brown elytra, without borders; the head, thorax, and wing-cases are covered more or less with a rather long grey pubescence; wings present. This *grey down* distinguishes it from the other *Phyllobius* weevils, which are for the most part beset with green *scales*. The antennæ (horns) are twelve-jointed and elbowed, the club elongate-ovate; the rostrum (or proboscis) shortish; eyes rather prominent; the legs yellowish or brown.

When the downy coating has been rubbed off, the black skin of the head and fore body is very noticeable; and where bad attack is found going on in May from a little downy brown beetle, with more or less of black showing on head and fore body, an elongate narrowish shape, and pale legs, it may pretty surely be considered to be this species.

On May 18th I was favoured with good specimens of these little weevil-beetles from a locality in Kent, with the following observations:—

"They infest my Apple and Pear trees; the piece of ground they are on has been neglected for years, and nothing at all done towards destroying insect life, so at present I have the ground and trees full of them. I washed all the trees this winter with strong caustic solution, and once this spring with soft-soap, quassia, and Paris-green, and now they swarm. I intend washing the Apples and Pears this week with a solution of soft-soap, seven pounds; paraffin, one quart; Paris-green, five ounces, to one hundred gallons of water, hoping to make a beginning of clearing them off."

The specimens sent were very characteristic examples of this "Oblong Weevil"; the long coating of hairs, or pubescence, on the beetle was very noticeable, as was also the black border, which sometimes occurs in this species, to the variably coloured wing-cases, which in this instance were reddish.

On June 1st another application was sent me,* accompanied by specimens, which proved to be of the same kind of beetle, and the observation:—"I may say that they have done me very great damage

* The applications were sent me by heads of well-known firms; but as it might not be agreeable to them to have their names mentioned in connection with a troublesome fruit tree infestation, I only mention that the localities were very far apart, one being in the south-west, the other in the south-east of England.

for years past. They appear about the first week in May, and eat the young buds of the Apple trees, &c. We have been catching them in large milk-pans, with a little paraffin oil put in the pan, which kills them very shortly. P.S.—I may say the weevils are now disappearing very quickly."

We do not appear (so far as I am aware) to have any English observations as to the life-history of this beetle in its early conditions; but there appears no reason to doubt the accuracy of the life-history given in Kollar's 'Insects,'* from Schmidberger's observations, although Nordlinger supposed that the larvæ went *not* into the ground, but into rolled-together leafage. The life-history is given as follows:—"In June the female enters the earth to deposit her eggs there; and the grub that is produced from the egg feeds on the roots of different kinds of plants, passes the winter in the earth, and appears again transformed into a beetle in spring. . . . It makes its appearance very early in spring, and is seen on the leaves when it has scarcely completed its development" [that is, presumably before it has gained its full colouring, Ed.]. "It particularly prefers young trees, to which it is very destructive. No kind of fruit tree is secure from its gluttony; the leaves of the Pear, Apple, Plum, and Apricot, and particularly those of the Peach, it considers delicious food. It generally selects only the best part of the leaf, and leaves the mid-rib and the petiole."—(S.)

Dr. Taschenberg notes this attack as frequently causing great damage in nurseries of young trees by destroying the buds, and also preying on the grafts and young leaves.

Prevention and Remedies.—Beating the beetles down in the early morning, or on dull days, is one way of lessening their numbers; and bearing in mind that as they are *winged*, the various precautions always advised should be taken against the disturbed beetles flying away and coming back to the trees.

Likewise washings or sprayings, as mentioned at p. 129, or of any other insecticide poisonous or destructive to the beetles, and harmless to the leafage, could not fail to be beneficial.

To protect grafts, it is recommended to smear grafting-wax, or a mixture of clay, which might keep off the beetles. (I have no experience of this treatment myself.)

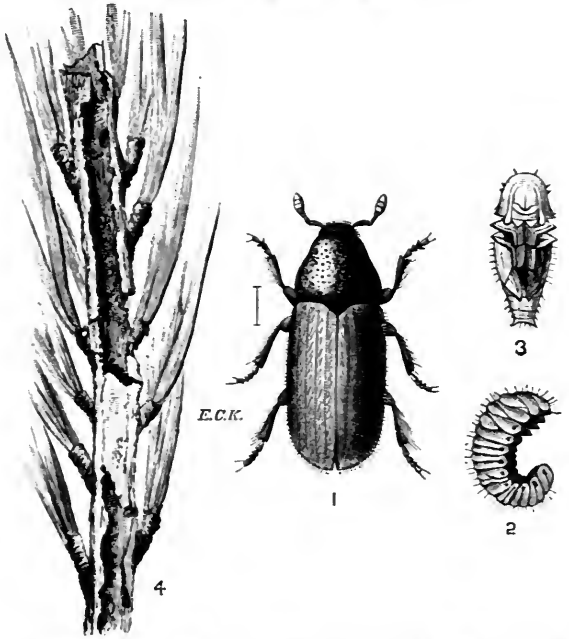
For winter treatment, anything done to the bark would presumably be quite useless, as, so far as appears, the larvæ and chrysalids are

* See Kollar, 'Naturgesch. der Schadl. Insekten,' pp. 258–260; English translation, pp. 251, 252, in which this weevil is noted under various synonyms. In the English translation, revised by Prof. Westwood, that of *Nemoicus* is added, being the generic name under which Stephens separated this downy and *scaleless Phyllobius* from the scale-bearing species.

never to be found there, nor have we any notes of the beetles wintering in its crannies. But probably where the soil beneath the trees could be treated, we might do much there towards getting rid of the infestation. Skimming the surface and destroying it would do good if we could be sure we went down low enough to remove the grubs; but these being so very small, it would be difficult to detect their presence in the earth. But where the ground was bare, it would be well worth while to try the effect of as heavy a dressing as the owner thought safe of some chemical manure, as kainite, nitrate of soda, or any other application which (similarly) we know to be good for plant growth, and injurious to at least some kinds of insect life.

PINE.

Pine Beetle. *Hylurgus piniperda*, Linn.



HYLURGUS PINIPERDA.—1, beetle; 2, larva; 3, pupa: all magnified, with line showing natural length of beetle. Pine shoot tunnelled by beetles.

Early in January of the past year (1896) a few letters appeared in the columns of 'The Scotsman' which are of great practical value as evidence from local Scottish observers of the great extent to which

Pine Beetle attack is fostered by leaving the fallen or injured Pine wood, beneath the bark of which it breeds, uncleared. We are well aware of such being really the case; but we have so rarely record of observation of great presence of the pest in absolute sequence with occurrence of great gales, and of weather injurious to the trees, over such a large area of country, that, with grateful acknowledgment of the source of the letters, I quote two of the most important almost at full length.

On January 8th, 1896, the following letter appeared in 'The Scotsman,' from Mr. Edward H. Robertson, of Burnside, Forfar:—

"The ravages of the Pine Beetle (*Hylurgus piniperda*) among the Scotch Firs are causing several proprietors in Forfarshire serious alarm. This insect is rather smaller than a grain of wheat; it burrows into the pith of the shoots of the Scotch Firs, where it lives in apparent security from birds or the effects of severe weather. . . . Possibly its prevalence at this time may be due to the enormous amount of blown and decaying timber in the county, or perhaps the severity of last winter removed one of the checks appointed by nature to keep it within bounds. The consequences of its work are only too apparent; Scottish Firs, old and young, are becoming bared of their shoots, and the ground strewn with branchlets that have dropped off by their sap being eaten away. The beetle's wings enable it to extend its ravages. The questions naturally present themselves—Is this scourge likely to continue? Can we hope that a hard winter will annihilate these comfortably-housed miscreants? Must we consider as probable the total loss of our Scottish Fir plantations? It is to questions such as these that answers from persons of experience would be valued, and for this object I ask you kindly to insert this letter."

The subject was further continued on January 9th (in the same journal) by a correspondent signing "Entomologist," giving some very correct remarks as to the breeding-grounds of the insect, and (in the first sentence) some very noteworthy observation of the prevalence of the beetle in localities where wind-fallen Scots Fir had been left unremoved:—

"There is no doubt about the Pine Beetle being too plentiful in some parts of Forfarshire, and for that matter in other parts of Scotland, where Scots Fir has been blown over by the gales in recent years, and allowed to lie, and often decay, where it fell. These blown-over and sickly trees are the breeding-ground of the Pine Beetle, and many other noxious forest insects. The remedy is to clear away as quickly as possible all fallen or cut trees; burning the *débris*—bark, branches, &c., and also strip the bark off the stools for six inches below the surface and burn it too. That will get rid of the worst breeding-ground for the beetle; and by encouraging all manner

of insectivorous birds and animals, the beetle will be kept within due limits, if not exterminated altogether. It does not breed in the tunnels it eats in the pith of the shoots."

As some reference had been made to myself as a writer on the subject, I forwarded a communication, which appeared in 'The Scotsman' of January 11th, which just puts in small compass all which is perhaps needed for common service regarding the life-history of the beetle, namely, the two distinct localities of the infestation, the egg-laying and feeding of the grubs up to their changes to beetle state beneath the bark of the fallen or sickly timber, and the winter shelter of the beetles in the Pine shoots, as more particularly noticed by Mr. Edward Robertson. I remarked:—

"I am happy to be able to say that this is one of the forest infestations that it is easily possible to keep down by really practicable measures based on the known habits of the insects.

"Your correspondent excellently describes the winter state of the infestation—it burrows into the pith of the Fir shoots, where it lives in apparent security. But it is not in these burrows that the beetle lays its eggs and the maggots feed. The regular course of operations is for the beetles to come out in April and May, and the females then bore their galleries by piercing a little hole through the bark of boughs, young trees lately felled, &c., and there each female gnaws a tunnel just below the bark, and lays her eggs along each side of it. The maggots soon hatch, and each maggot gnaws its own tunnel somewhat at right angles to the mother gallery, and when full fed, which is towards July or August, they turn to chrysalids, and thence to beetles at the end of their tunnels, and then each beetle bores a little hole through which it emerges. It is these beetles which (as the next stage in mischief) fly to the neighbouring trees, pierce the shoots, and there establish themselves.

"The great point of prevention is timely removal of the material in which the beetles breed.

"Your correspondent is perfectly correct in ascribing prevalence of the pest to 'the enormous amount of blown and decaying timber in the county.' The special breeding-places of the beetles are where the wood is still alive, but where there is no healthy flow of sap. Therefore decaying branches on or under the trees, and fallen trees, are especially maggot nurseries; also where dressing off of bark or outsides of Fir thinnings is permitted in the thinned plantations, and this rubbish not cleared away, it is apt to swarm with maggots.

"Also where thinnings of young plantations have not been all removed, but some heaps of the young trees left, it has been found that the shoots of the trees close by have been infested near each heap.

"Attention to the above points, by clearing all breeding localities,

is the best and, indeed, the only way of thoroughly checking increase. Where trustworthy attention can be given, the plan may be worked out still more thoroughly by leaving a quantity of suitable rubbish—as, for instance, some lengths of felled Pine tops—about, and towards June examining these, and (if the maggots are found present) burning them. This acts well by attracting the beetles that are about, to where their mischief can be kept under supervision.

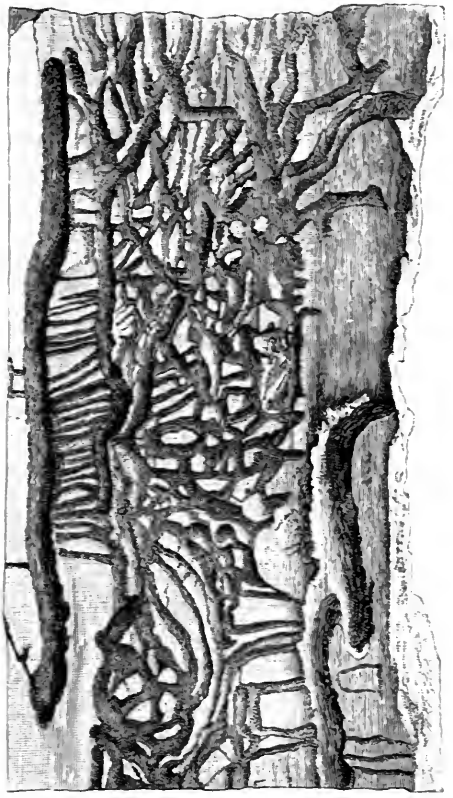
"At present it would be very desirable to collect and burn all fallen shoots, on the chance of a good proportion being still infested; but this does not act fully as a preventive, for the beetle (the *H. piniperda*) also hybernates in rubbish—'fog,' as it is sometimes called—which has fallen from the trees. Trusting that the above may be of some service, I am, &c., Eleanor A. Ormerod, F.E.S."

The following communication, consequently on the above correspondence in 'The Scotsman,' was sent to me on March 6th by Mr. W. F. Melvin, of Dilkusha, Montrose, N.B. In this it will be seen he reports the result of his official examination of the Fir plantations of the Burgh of Montrose to be that they are damaged by loss of shoots, in which the beetle "seems to have taken shelter for the winter, and several hundreds of trees dying or dead have their bark riddled with small holes." We have thus observation of another large district suffering what we may call wholesale damage; and I give Mr. Melvin's letter and the following one almost *in extenso*, as the other points brought forward therein are also such as it is serviceable to be well informed on. Mr. Melvin wrote as follows:—

"Several letters in 'The Scotsman' during the month of January on the 'Pine Beetle' attracted my attention, and led me to examine the Fir plantations belonging to the Burgh of Montrose. As a member of the Town Council, I was lately appointed Convener of the 'Parks and Gardens Committee,' and hence all the trees belonging to the Corporation have been placed under my care. I find that many of the Scots Firs and other Pines have been damaged by the beetle,—in fact, the ground is strewed by fallen shoots, in which it seems to have taken shelter for the winter, and several hundreds of trees, dying or dead, have their bark riddled with small holes. On stripping the bark I notice numerous larvæ or pupæ in the small tunnels, soft pure white creatures from an eighth to one-fourth of an inch in length. Dr. Gunning, of this place, met me in the wood yesterday, and he is of opinion that these are the beetle in its various stages; but from your 'Manual of Injurious Insects,' I am almost certain that the larvæ of the Pine Beetle are not in the bark so early in the season. As I read your valuable book, the egg laid in April or May becomes a beetle in some four months, and then leaves the trunk for the tender shoots, in which it remains over the winter.

"I have had the marked trees cut down, and these, as well as all the shoots, removed, the latter being at once burned; but I am in doubt about the former as to how I should dispose of them.

"If I am right in believing that the larvæ under the bark are not those of the Pine Beetle, I shall dispose of the trees by auction, and so get rid of them; but if they are those of the Pine Beetle, I shall order all to be burned in the fields outside the plantation. Dr. Gunning



Inside of Pine bark, showing tunnelling of Pine Beetle and maggot.

is, I understand, to send you specimens of the larvæ, so that you will be able to say what they are: meantime, I shall be greatly obliged if you will let me know whether it is at all probable that larvæ of the Pine Beetle are to be found under bark during the winter."

On March 10th Mr. Melvin again wrote as follows:—

"I have forwarded by parcel post several slabs of different trees which contain larvæ and pupæ, which you may be able to identify."—(W. F. M.)

The slabs of Pine bark (with wood still attached) sent March 10th, 1896, contained many perforations like shot holes, showing for the

most part exit holes of the Pine Beetles which had been developed within, in some cases entrance perforations of the parent beetle. On splitting off the bark from the wood beneath, which was easily done from the destructive amount of larval workings between the two, I found the mother galleries, with side workings from them, clearly defined, and also a very large amount of workings, quite irregular in their various directions, consequently on the crossing or interlacing of the course of the larval galleries. The appearance was so excellently conveyed in the figure (p. 135) given by the high forester, Herr Eichhoff, in his valuable work on Bark Beetles, that I copy a portion of it with acknowledgment of the source, as an authoritative representation, such as Herr Eichhoff's, is of great importance for reference.

The figure below shows one of the large galleries tunnelled out by the mother beetle, along each side of which (in favourable circum-

Beetle and larval galleries.

stances) she lays her eggs; the maggots which hatch from these working away from the mother gallery in such regular order as to form, where there is room for their operations, a feather-like figure, as shown in my own little sketch. But commonly, where there is much infestation, the galleries become confused together, as shown in Herr Eichhoff's figure.

On examining the slabs of wood sent me on March 10th, though there were galleries in plenty, I could not find any of the makers of them present. There were maggots of some kind of two-winged fly, presumably living on decaying matter. These were yellowish white, long, and worm-like in shape, legless, and furnished with small heads,—in fact, much resembling larvæ of some species of *Sciara*.

Also there were other larvæ present, cylindrical, of a kind of miniature pear-shape, so much attenuated at one end as to be bluntly pointed. These I conjectured to be parasites, but as no other larvæ were to be found without breaking up the bark, and thus wasting what might give developed insects presently, I folded the specimens of wood carefully together to wait further development. These specimens I left either untouched (or very carefully removed once or twice from their wrappers for purposes of examination) for many weeks in a locality favourable for development. But, neither by examination of living larvæ, nor by any specimens developed in the packet containing the plentiful supply of long and wide pieces of wood with bark attached (commonly called slabs), did I find any presence of larvæ (maggots) of Pine Beetle, or of the beetle itself. This large collection of specimens fully confirming the view, long held, that the maggots, after feeding in their tunnels between the bark and wood so as to infringe on both surfaces with their gnawings, and also working more or less into the substance of the bark, turn there (each maggot at the end of its own gallery) to chrysalis condition, and thence to the perfect beetle. These beetles, making their way out by the shot-hole-like perforations (see p. 133), fly to the Pine shoots, which they tunnel, and thus cause broadcast destruction.

The larva or maggot of the Pine Beetle (*H. piniperda*) is about a quarter of an inch long, fleshy, wrinkled across, and legless, largest in the rings behind the head (see figure, p. 131); the general colour white, but ochrey near the head, and also somewhat ochrey in tint towards the tail; head dull yellowish.

The larvæ turn to pupæ at the end of their galleries beneath (or in) the bark, where the beetles complete their development, bore through the bark, thus causing the shot-like holes so observable in bark of infested trees, and then fly to growing shoots, which they tunnel and destroy, but only use as shelter, not for places of egg deposit. The beetles come out from the timber about the middle of the summer, it may be from the end of June until the end of August.

The Pine Beetle is about the fifth of an inch in length; pitchy or black; wing-cases rather lighter in colour, somewhat rough, with rows of fine punctures, alternating with rows of little bristle-bearing tubercles (these absent on the apical portion of the second interstice). Fore body somewhat smaller in front, and (as well as the head) punctured; antennæ clubbed at the end, and, as well as the feet (tarsi), rusty red, or brown, or yellow brown.

The following letters refer to the autumn and winter form of mischief, caused solely by the Pine *Beetles*, after they have escaped from their places of development beneath the bark of the timber, flying

to the living Fir trees, and tunnelling up the live shoots, not as breeding-ground, but simply as places of shelter.

Mr. Lambert's communication is of rare interest as connecting unusually severe attack of this infestation with destruction of trees to a most unusual extent in this country,—"thousands of trees piled one on another,"—and this caused by such an unusually violent gale, that it stands recorded in Symons's 'Monthly Meteorological Magazine' as "The Great Gale of the Midlands, of March 24th" (1895),* with details of the extraordinary amount of mischief caused in many ways, but especially the damage to trees, up to 1100 being blown down in a single park; and also to their lying, as described by Mr. Lambert, piled one on the other. These circumstances would afford a magnificent breeding-ground to the beetles, of which it will be seen they were not slow to take advantage, as shown by the attack on the Pine shoots in the following year (1896).

On September 21st Mr. L. F. Lambert wrote me, from the Hewell Estate Office, Redditch, Worcestershire, as follows:—

"I should be so very much obliged if you would tell me what the name of the beetle is that is attacking our Scotch Firs. I am sending you a few shoots to show you the nature of the attack."

After examination of the plentiful supply forwarded (of which I give details below), I wrote at length to Mr. Lambert on the subject, and on September 26th received the following reply relatively to my suggestions as to presence of the attack being from damage to timber:—

"One half of this plantation, containing several thousand trees, was blown down by the great gale of March 25th, 1895. It took us many months to cut out the trees, which were all piled one on another; and from your letter I have no doubt that this attack of the Pine Beetle is the indirect result of the storm."—(L. F. L.)

The Pine Beetle borings were excellent specimens, with beetles alive and very active in some of them; and they afforded such a good opportunity of noting this part of the year's attack in detail, and especially that several beetles would attack a single shoot, that I was at some pains to observe the state of things as minutely as I could, and give the notes below, and a figure of one of the shoots, as split open to show the borings in the central pith, at p. 131.

Specimens of damage caused by Pine Beetles boring living Pine shoots, sent to me by Mr. L. F. Lambert, September 21st, 1896:—The galleries along the shoots were in different stages of progress. In one instance, where the clean and fresh appearance of the perforation showed the work had been very recently begun, the tunnel was only about three-quarters of an inch in length, and the beetle within in very active state; another tunnel on the same shoot was only about

* See Symons's 'Monthly Meteorological Magazine' for April, 1895, pp. 41–43.

an inch long, also with the beetle within, and also with no second perforation observable.

In another, one and one-eighth inch long, there were two perforations, one at each end, and the beetle so very active as to show the necessity of precaution against escape where the preventive treatment of cutting off the infested shoots is adopted.

Another tunnel, about an inch long, open at each end, was vacant; in another, with the beetle within, the tunnel was worked so completely to the outside bark that the strength of the shoot at this part was quite gone, and the Pine leaves (needles) above had lost their healthy colour.

One of the shoots which showed the worst attack was six and a half inches long, and contained three burrows,—one starting at the base; one at the extremity, which was killed, brown and leafless; and another about midway between the two. In this case the attention of the most casual observer would have been attracted to the sickly yellow and stunted growth of most of the leafage, this increasing from the two or three moderately healthy pairs of needles at the base up by way of the quite stunted yellow needles to the bare destroyed top.

Another thicker shoot of five and a quarter inches in length gave a most interesting example of destruction. This, to general observation, appeared, when split along the centre, to be tunnelled (excepting one length of about a quarter of an inch) throughout, but on examination the mischief consisted of a series of galleries formed by different beetles along the shoot, the terminal part being completely killed by the gallery within being hollowed away and the beetle gone. In another shoot there were similarly three galleries, two with a beetle within; and in another the beetles appeared not to have calculated accommodation before beginning perforation. This shoot was a vigorous growth, fully half an inch in diameter, and in one case the two galleries had been begun so near, that the respective owners were within about half an inch of each other.—(E. A. O.)

I do not think it is possible to have better examples of presence of breeding grounds below Fir bark, and non-presence of *H. piniperda* larvæ in them in the winter; also of presence of the Pine Beetles in Pine shoots in autumn than those furnished, respectively, by Mr. Melvin and Mr. Lambert; and joined to this, and also to the reports of the correspondents of 'The Scotsman,' respectively from Mr. Robinson, Forfar, and "Entomologist," we have the evidence of the great attacks observed in Forfarshire, Montrose, and Redditch, Worcestershire, following in the track of severe gales, and in the northern counties named also of such severe winter weather as caused injury to the trees. Thus altogether we have such *broadscale proof* of the infestation under consideration following, as has long been held from

observation of smaller areas (so far as this country is concerned) to be the case, where material has been left for breeding purposes, that it has seemed of interest to give the observations in detail.

Prevention and Remedies.—The main point to be attended to is to clear away all fallen Pine timber, or fallen or injured boughs, or felled poles, or trimmings from felled timber, *which might serve as breeding-grounds for the infestation*. The beetles as a regular thing choose places for egg-laying where the sap is not in full flow, and on the fallen timber, or half-killed branches, or in the Pine poles trimmed and thrown in heaps to be carried away at some future or more convenient time, the material is quite moist and soft enough to afford food for the maggots, without their being stifled by a flow of turpentine into the galleries, and the instinct of the beetles leads them (for egg-laying) to material in suitable condition.

Fallen timber and fallen or injured boughs obviously require looking to; but clearing off the rubbish left in thinning plantations is not always thought of. In some information given me some years ago by the well-known head forester, Mr. W. McCorquodale, of Scone, N.B., he mentioned:—

"When young Fir plantations are thinned, all the brush ought to be at once removed, or burnt on the ground, as the beetle propagates in the decaying branches in legions. . . . When Fir thinnings are carted from the plantations, it is a very common practice to dress the bark off, to lighten the carriage in transit to market. The dressing off of the bark should not be permitted within the plantation; in a year after, the ground round these heaps of bark may be seen covered with brown shoots blown from the growing trees, bored by the beetles which the heaps have nurtured."

It has also been observed that where most of the thinnings from a young Pine wood had been taken away, but some piles of these left, that near every one of these piles the mischievous work of the beetles was observable.

But with regard to the above thinnings, trimmings, &c., some small proportion of them *may be made useful as traps*. As late as May the beetles may be found at their egg-laying work,—in an instance especially recorded on young Scots Pine trees, or poles cut down in the previous January,—and it answers well to leave a fair number of these to attract attack, and after laying time is over, and before the maggots in the trap-wood are come to development, to collect the traps and burn them. Some time in June would probably be early enough, but this could easily be known by raising a piece of bark from time to time, and seeing the progress of the maggots. Where pieces of trimmed-off boughs or lengths of young Scots Fir tops with the

branches trimmed off are used for traps, they are said to answer best by being set up against the trees, not laid flat on the ground, where they would be in wet grass or surroundings. The fallen timber lies partly above the grass, but the poles and boughs are more readily covered.

Clearing the shoots which have been tunnelled by the beetles is rather a difficult matter. It would be useful if it could be done, but many are out of reach on the trees, and when they fall below, it is a great chance if the beetle is to be found within. But if collecting is tried, this should be done into a pail, with sticky material in it, which will prevent the beetles getting away, for they are very clever, on alarm, at rapidly leaving their burrows and falling to the ground. Many of these beetles hybernate in the forest rubbish; but here it seems impossible to bring remedial measures to bear, as firing it in weather dry enough for the purpose would probably be ruinous to the plantations.

The great point of counteraction of this attack is careful removal of all possible breeding-places.

H. piniperda in Larch (*Larix europæa*, Decandolle).—Although this infestation is chiefly recorded as attacking Scotch Fir (*Pinus sylvestris*, Linn.), yet it is not limited to this species, but is found to occur on other kinds of Pines; and we have a very notable example of it being found by Dr. W. Somerville (Lecturer on Forestry in the University of Edinburgh) in his own Larches on the estate of Corniston, Lanarkshire, N.B. The account of this attack was given by Dr. Somerville, from his own personal observations, in a paper read by him before the Royal Society of Edinburgh, on July 7th, 1890, in which he drew attention to the circumstance that, "as occasion demands, this insect has been found to utilise as a breeding-place every species of *Pinus*, but, so far, in Europe or North America, no case has been noted of any trees belonging to the genus *Larix* having been similarly attacked." In Asia (Dr. Somerville noted) a case had been recorded in the district of the Boganida, in Siberia.

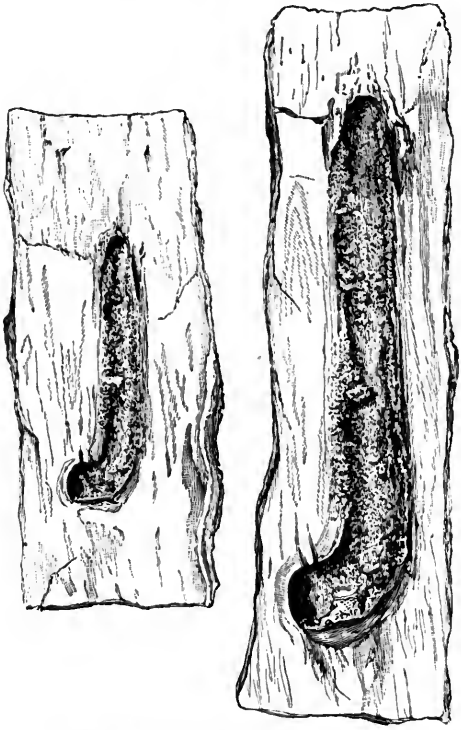
In the case of Dr. Somerville's trees, he noted that in the beginning of the year of his report (1890), in the Upper Ward of Lanarkshire, on a south-west slope, at an elevation of some 800 feet, he found that several Larches, which had been felled during the previous winter, were attacked by large numbers of this insect. *Hylastes palliatus* was also present, but by far the greater number of galleries were the work of *H. piniperda*.

Dr. Somerville noted:—"The greater abundance of fluid resinous matter in the Larch, as compared with the Scots Pine, seems to have considerably interfered with the work of forming galleries. . . . Even in some of the trees attacked I found unfinished galleries quite full of resinous secretions, and containing the dead bodies of the male and female insects, which had doubtless been drowned or suffocated by the resinous exudations."

Dr. Somerville was kind enough to give me a copy of his paper, with permission to make use of his information, which I gladly availed myself of in my Annual Report for 1890; he also favoured me with a specimen of the infested Larch bark showing several examples of

the mother gallery of the Pine Beetle, one of which (here reproduced) I had carefully figured, so that it gives a very correct representation of the gallery, natural size and magnified.

These figures show how the flow of turpentine, now hardened into an irregular coating, has stopped development of the young maggots, though, if carefully examined, the figure shows in places the little niches of commencement of attack along the sides of the gallery. This point (of the flow of sap checking development of attack) is of so much practical interest, that I wrote further on the subject to Dr.



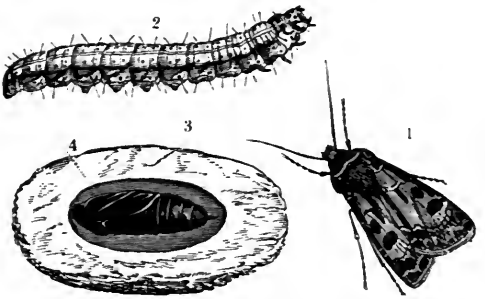
Mother galleries of *H. piniperda* beneath Larch bark, natural size and magnified. From Dr. Somerville's specimens.

Somerville, who kindly replied to me as follows:—"I delayed answering your letter till I had made another examination of the Larch trees, and I am now able to answer your questions fully. The trees which were attacked by *H. piniperda* were taken possession of by great numbers of this insect, which laid its eggs in little niches as usual; these in due course hatched out, and the larvæ proceeded to eat into the bast, but the resin had proved too much for them, for in no case (at least in no case that I have observed) did they develop into beetles."

For the information *in extenso* the reader is referred to Dr. Somerville's paper, as before mentioned; but the attack is one of such rarity, and also of such curious interest as showing how the flow of sap is unsuitable for egg deposit (as alluded to at p. 140), that I have repeated some of the chief points.

SURFACE CATERPILLARS.

Caterpillars of "**Turnip**" or "**Dart**" **Moth**, *Agrotis segetum*, Ochsenheimer; and of "**Heart and Dart**" **Moth**, *Agrotis exclamationis*, Linn.



AGROTIS EXCLAMATIONIS.—Moth, caterpillar, and chrysalis in its earth-cell.

"Surface Caterpillar" attack was the chief agricultural infestation of the year; it was widespread, did much mischief, and lasted for a long time. The first enquiry regarding the nature of the attack was sent me on July 10th; this was followed by frequent enquiries, occurring daily, or almost daily, in the latter part of the month, and continued some way into August; in September there was some slight mention of attack, and on October 30th I had again notice of the caterpillars as doing great mischief to the roots of young Gorse in coverts.

This attack has been so often entered on that the reports would not be of interest to give at length; but the following short notes of locality, date, and general statement of amount of injury to the crops of the writer, or in his neighbourhood, taken from some of the letters of enquiry, may be worth record, as showing the widespread prevalence of the Surface Caterpillar attack in England. I had no notes of it from Scotland, and only two from Ireland.

Aston Glebe, Poyntz Pass, Co. Armagh, July 10th.—Attacking young Mangold; but earlier sown Mangold escaped the grubs, and Turnip not touched.

Lubstree Park, Wellington, Salop, July 13th and 25th.—Made sad havoc with the young Turnip plants; after repeated sowings they have swept the young plants off.

Ossemsley Manor Farm, Lymington, Hants, July 14th.—Looks as if the small breadth of Mangolds left was going to be destroyed by Surface Caterpillars.

Thornton, Berwick-upon-Tweed, July 14th.—Destroying my Mangold plant.

Parlington Estate Office, near Leeds, July 18th.—Eating off Mangolds very fast.

Rendcomb Park, Cirencester, Glos., July 18th.—Destroying the roots at Rendcomb.

Hill Farm, Sketty, South Wales, July 22nd.—Swedes going so fast; am afraid in a few days we shall have none left.

Nuttall Temple, Nottingham, July 23rd.—Fast destroying a field of white Turnips.

Bourne Park, Canterbury, July 24th.—Field of thirteen acres appears totally destroyed.

Fassaroe, Bray, Co. Wicklow, July 25th.—Destroying the Turnip crop of the sender.

Charlton Park, Malmesbury, Wiltshire, July 26th.—Swarming among my Turnips.

Kingsbridge, Devon, July 27th.—Neighbours have lost acres.

Audlem, Cheshire, July 28th.—Destroying Turnips in this district.

Milborne, Blandford, Dorsetshire, July 30th.—Greatly suffered from grubs eating off the plants.

Aspatria, Cumberland, August 1st.—Grubs are clearing the Turnips off around here wholesale.

Hendrefoilan, Sketty, South Wales, August 3rd.—Surface Caterpillars very destructive in the Swedes in South Wales, and causing a great loss in some places.

Wychnor, near Bakle, Sussex, August 12th.—Surface Caterpillars at Turnips on writer's land in Kent and Sussex; and in the Sussex land so bad at Mangolds, that some of these with roots as large as a quart pot were withering away.

The above short notes, extracted from a portion of the letters sent me, may suffice to show how widely prevalent the attack was over the country.

Specimens of the caterpillars, which were sent me in all cases, proved to be of the common Surface Caterpillars known as Turnip Grubs, and apparently, for the most part, of *the* Turnip Grub, *Agrotis segetum*. But this kind so much resembles the other very common kind, *Agrotis exclamationis*, that I should not like to speak positively. The two sorts are similar in their habits of ravaging, as occasion offers, at Turnip or other root crops, and almost any roots that may fall under their power, as Beet and Mangolds, Potatoes (sometimes to an extent necessitating early raising), Carrots, Onions, Leeks, Cabbage, and even the roots of Grass, Wheat, and corn generally. But, owing to their special prevalence at Turnip roots, the name of Turnip Grubs is often given.

With regard to appearance, the two kinds mentioned above are very similar in being, when full-grown, from about an inch to an inch and a half in length, fleshy, cylindrical, sixteen-footed, of a somewhat grey, or brownish, or pinkish, or purplish general colour; the head dark or dingy brown, armed with black jaws; the next ring to the head brown with paler lines, or (in *exclamationis*) margined in front with dark brown, with a pale line passing through it; on the back of each of the other rings or segments are four little black dots, or little tubercles, each with a short hair growing out of it; and there are also some spots at the side lower down, and more or less noticeable dark and pale stripes along the back.

For practical purposes the above description is sufficient to distinguish them from other larval pests to be found not unfrequently accompanying, as Chafer grubs, Daddy Longlegs grubs, or Wireworms. But to myself it seems, owing to chance variations from different circumstances, also differences which do or may exist after successive moults, and also the special difficulty of condition after postal transmission altering external characteristics, that it is next to impossible, without rearing the caterpillars to maturity, to speak with absolute certainty as to their *specific* name. In the excellent description of the larva of *exclamationis* (grub of Heart and Dart Moth), given in 'Larvæ of British Butterflies and Moths,' Buckler, vol. v. p. 9, it is stated that "an infallible guide is found in the extra large spiracles which distinguish *A. exclamationis*"; but I do not always find this difference in size sufficiently well marked to rest upon.

Last season (1896) I received Surface Caterpillars from half an inch long or less up to being nearly or quite full-grown, and they afforded excellent examples of their carnivorous habit of preying on each other when food falls short.

Amongst a number of grubs received from Berwick-upon-Tweed on July 14th, I found, on examination, that one of the largest, then either dead or nearly so, had a largish hole torn open in the side, and one of the smallest was greedily swallowing the moisture or accessible contents, its jaws working quite fast and noticeably. About half an hour after, this one appeared satisfied, and two others were feeding on the now dead caterpillar at the same spot, and another endeavouring to make a new hole through the skin at another spot. On one of the other caterpillars coming near, this, turning from the dead one, tried to catch hold with its jaws, but was not allowed.

In another case I found one of the larger caterpillars holding on to a smaller one, and on taking the lesser one up, I found moisture on my fingers, and that there was a hole in its side, presumably the beginning of devouring its contents on the part of the larger grub.

The method of life of the caterpillars is to continue to feed (weather

permitting) through the winter, and return fully to ravaging with the return of warmer weather; sometimes, as in 1884 and the following year, doing great mischief even in February and March. Towards May or June they turn to chrysalids in the earth, and the moths appear about a month later.

The figure (p, 143) gives a very good idea of the Heart and Dart Moth in its different stages. The moths of both kinds have the upper wings with variously distributed shades of grey and brown; the hinder wings of *A. segetum* almost entirely pearly white; and of *A. exclamationis*, white, with upper margin and nerves brownish in the male, and dark brown in the female.

The reports sent referred in almost every instance, excepting the following, to attack of the Surface Caterpillars to Turnips or Mangolds; but in this one instance we have such a well-described account of the attack of the pests to young Gorse, *Ulex* (*? europæus*), that I give it almost at full length. Such a severe attack on this plant not having, so far as I am aware, been recorded before, the notes may prove of very practical interest.

On October 30th Mr. Robert T. Collins (forester), writing to me from Trentham, Stoke-upon-Trent, forwarded me specimens of Surface Caterpillars which I could not see differed from larvæ of *Agrotis segetum*, and which he mentioned were working sad havoc in young Gorse coverts in that neighbourhood, with request for information regarding them. The caterpillars were then only about half grown.

Mr. Collins noted as follows:—"I purchased last spring just over £100 worth of Gorse seed (French I bought it for), and sowed it on both light and heavy land.

"The larvæ sent come from light land,—gravel on the highest part, and sloping down to the north to a sandy loam.

"The seed was sown May 13th in rows with corn drill, every other pipe being stopped up, making the rows fourteen inches apart. This came up very thick indeed, and at the end of July the larva began to eat the young Gorse, in some cases below, and in some above, the cotyledons, eating most of it clean off; but some pieces had the side only eaten for an inch or more in length, which fell over, hanging by a piece of the bark. This went on through August and September. Most of the damage is down the slope.

"The grubs feed at night, and go down into the ground beside the roots in the daytime; and they have almost devoured some five acres of it.

"There was an old Gorse on this spot, which I cut down and burned, and trenched the ground before sowing.

"I have sown other coverts some ten miles away on either side of here, on stiff heavy clay, and these have suffered somewhat similarly,

the grubs appearing to me to be the same; and though I have been sowing Gorse coverts for twenty years, I have never suffered from such an attack before."—(R. T. C.)

PREVENTION AND REMEDIES.—We seem to have really made a little advance in remedial measures in the past season by the addition of dressing with nitrate of soda and salt mixed, and hand-sown after hoeing between the rows and between the roots.

Hitherto the only available methods of treatment with us have appeared to have been free use of the drags and harrows, especially amongst young crops, and also much hoeing; likewise the very costly though sure plan of hand-picking the caterpillars from the infested roots. This last certainly is a complete cure, but it has to be considered whether the large outlay or the whole or partial loss of the crop is the greater evil.

In the past year I had the following note relatively to hoeing as an attempted remedy from one of my yearly correspondents, Mr. S. B. Burroughes, Wiveton Hall, Holt, Norfolk, which shows the severity of the attack which he was then trying to clear:—

"Enclosed you will find some grubs which are taking my Turnips off, especially the small ones; we find seven or eight at a root. I have ten men in a ten-acre field hoeing round the Turnips to disturb them all I can, and the horse-hoe close to hand. . . . There appear to be sufficient grubs to eat the whole crop; they eat the small Turnips through just beneath the surface of the ground."—(S. B. B.)

Another (or several) correspondents thought that joining hoeing and hand-picking would act well. Thus (instead of sending workers along the rows to stir out the grubs with a pointed stick, or old knife, and collect them into any convenient pot or pail for destruction) to let children, or workers at less cost than able-bodied day-labourers, follow the hoes, and gather all the grubs they could find.

The American plan of clearing the pests by placing bundles of food poisoned with Paris-green, or other arsenites, along the rows, appears to be much used there, and very successfully; but, I should say, was wholly inadmissible in this country on account of the great risk (or rather certainty) of poisoning any of the farm stock which might accidentally gain access to the arsenically-dressed food, and also the havoc it would make amongst hares, rabbits, and the like.

With regard to nitrate of soda and salt.—The trial of this was suggested to me early in last season's attack by Mr. D. D. Gibb, of Ossemsley Manor Farm, Lymington, Hants, and I mentioned the subject to various of my correspondents, amongst others to Mr. Herbert Prater, Parlington Estate Office, Aberford, near Leeds, who

had written to me regarding some method of stopping ravage on the Mangolds, which the Surface Grubs were then "eating off very fast."

In reply, on July 23rd, he mentioned that he was trying the salt and nitrate of soda, and thought it should do good.

On August 12th he wrote further:—"You will no doubt be glad to hear that the treatment you recommended for the grub which was attacking my Mangold has been completely successful in arresting the pest, and I am very grateful to you for it." And a little later, on August 20th, with the remark that he was anxious to make a few more observations about the Mangolds, he favoured me with a few lines of details of method of application:—

"I simply kept the hoes going freely in these Mangolds, both between the plants and between the rows, and I then hand-sowed down them some salt and nitrate of soda mixed, at the rate of about three cwt. per acre."—(H. P.)

The success of the experiment in this carefully observed instance seems to me to make it well worth while to try it again when the Surface Caterpillars begin to make their regular yearly reappearance.

TURNIP.

Turnip and **Cabbage Gnat Midge.** *Cecidomyia brassicæ*, Winnertz.

On October 12th I was favoured by Mr. W. Sim, of Gourdas, Fyvie, Aberdeenshire, with observations regarding a small maggot which he was finding very injurious to Turnip seed in the pod, and of which he enclosed me specimens. From these, and also from specimens of the Gnat Midge which he had reared from some of the maggots, it appeared to me the infestation was of the minute gnat known as the Turnip and Cabbage Gnat Midge, of which the maggots are to be found in great numbers sucking the seeds, and causing deformed growth of the seed-pods, of Turnip, Cabbage, Rape, and others of the Cabbage kind.

Mr. Sim's first communication was as follows:—

"*Injury done to the Turnip seed crop.*—When the seed-pods were nearly matured they suddenly turned yellow, and when handled they would open up in the same manner as if ripe and dry; but, instead of seed, a number of small white maggots would tumble out. The infested seed-pods contained from two or three to thirty, but generally from twelve to twenty, in each. The depredators eat the lining of the seed-pod as well as the young seed, hence the cause of it opening, I

believe. The Turnip Seed Weevil, or, rather, the larva of it, was also very destructive this season; but I know it by the puncture it leaves in the pod where it escapes.* The pest is most common on the Yellow Turnip, but I found it also on the Swede, and on Scotch Kale."

The larvæ sent by Mr. Sim agreed with the descriptions of that of *C. brassicæ* in size, colour, and texture.

On October 19th Mr. Sim sent me the following additional notes on the Turnip seed pest:—

"I had seed Turnips in several places; the worst attack was on 'Yellow Bullock,' in a piece of ground that had grown the same variety for some years in succession. I first noticed the pest on July 7th this year. The unaffected seed was ripe about a fortnight afterwards. The seed-pods attacked by this pest had much the same appearance as those that were attacked by the larvæ of the Turnip Seed Weevils. Although each species were equally destructive, each kind kept to their respective seed-pod.

"With the object of trying to breed the insects, I put some of the maggots in a flower-pot, along with a handful of fine mould, which I made sterile by pouring boiling water on it, so as to prevent mistakes. I put a cloth over the vessel to keep all insects prisoners; but though I looked in now and then, I never found any. When your letter reached me last week saying the larva belonged to the *Cecidomyia* tribe, I turned out the contents of the flower-pot on to a white paper, and went over it carefully with a hand-magnifier. The result was three midge-like insects, which I have no doubt are the real depredators, but I fear they are too much mutilated to identify. I think they had been hatched and dead before I thought of looking for them."—(W. S.)

These specimens were certainly Gnat Midges (Cecidomyiæ, scientifically), and though, as Mr. Sim observes, they were so much injured as to make identification difficult, still, judging by the neuration and other characteristics of the wings, and the colour of some of the parts that would not change after death, and some other points, specified below, I did not think that the infestation could be any other than that of *C. brassicæ*.

The following extract from 'Die Pflanzen-feinde,' of J. H. Kaltenbach, p. 34, gives the main points of the appearance of the larva, or maggot, and its history, shortly and clearly:—

"*Cecidomyia brassicæ*, Winn.—The larvæ live, according to Winnertz,

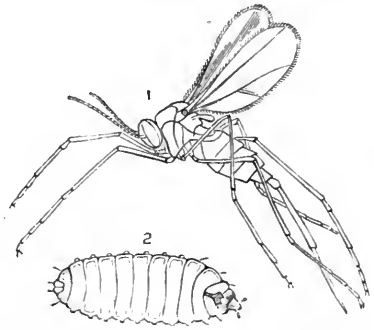
* In Curtis's account of "The Turnip Seed Weevil, *Ceutorhynchus assimilis*, Payk." (see 'Farm Insects,' p. 103), he particularly notices this point—that on splitting a pod with a small hole in it open, "it appeared that the hole had been made by a maggot in order to effect its exit. Three pods were also forwarded to me, each being punctured," &c.—(J. C.)

and my own observations, in the unripe pods of Rape, often up to fifty or sixty in one pod. In such great numbers they are injurious to the Rape seed, so that the pods swell or burst, become yellow and prematurely ripe, or their growth is entirely ruined.

"The larva is three-quarters of a line to a line in length, milk-white, with a yellow food-canal. The entire surface has the appearance of being granulated, and the hinder edge of the penultimate ring is edged with bristly hairs."

The specimens sent me by Mr. Sim on October 12th agreed well in general characteristics with the above description; the measurement was the same, and they were milk-white in colour, and the granulation of the surface was also noticeable, but I had difficulty in finding the anchor-process. This, however, I found on some specimens forwarded to me by Mr. Sim on October 19th.

This process (for position and form see accompanying figure) was of the usual form found in *Cecidomyia* maggots,—that is, a sort of



CECIDOMYIA LEGUMINICOLA.—American Clover Seed Midge and maggot, much magnified; maggot about one-twelfth of an inch in length.

stem or short narrow organ attached at one end to the lower side of one of the segments near the head, and pointing forward; the free end enlarged. In this case the stem was parallel-sided for about three-fifths of its length, and then swelling out, the extremity being about twice the width of the stem, flattened at the end, and not deeply bifid, nor yet with the sides curved back like the flukes of an anchor, but simply slightly "emarginate" (that is, with a slight indentation or notch) at the free extremity.

The "anchor-process," or "breast-bone," was not nearly as observable as is often the case with *Cecidomyia* larvæ; but by carefully clearing out all the contents, so as to reduce the maggot to merely an empty skin, I was able to get a good observation.

As at the time I had not convenient opportunity for figuring the larva, and the imagos were too much injured for representation except

in portions, I insert above a figure of another species of *Cecidomyia* and its larva, as a guide to the general appearance; and in the case of the maggot (with the exception of the anchor-process represented being more deeply notched than that of the species under observation) it gives a very fair representation.

The perfect insect, or "Gnat Midge," of *C. brassicæ* is rather less than the twelfth of an inch (1–2 mm.) in length, with head and back of thorax dark or black, with silvery hair; the abdomen flesh-coloured, usually with brown or black bands. Antennæ fifteen-jointed, those of the male shorter than the body, those of the female scarcely half its length. Legs black, silver white beneath, turning lighter after death. Wings transparent, flesh-colour at the base, very brightly iridescent; the fore edge black, as also the veins; and *the first long vein very near the edge.** The ovipositor yellowish white, with a capability of being greatly extended.

The specimens sent me had been so long dead, and were so much injured, that I cannot take on myself to state their species with certainty; but the position of the foremost long vein near the fore edge of the wing was very observable, and so also was the remarkable iridescence of the wings. Both Professors Schiner and Taschenberg note that this kind turns black after death, which was certainly the case with my specimens, but may be the case with other kinds also.

The following notes, by Dr. J. Ritzema Bos, give the life-history of the infestation at greater length than I have been able to find it elsewhere:—

"The maggots, which are about two millimetres in length, are milk-white, with the yellow food-canal showing through the skin; they are to be found in the last half of May and in June in Rape-pods, and may be found there in very great numbers, even up to forty or fifty in one pod, where they suck the unripe seeds to such an extent as to destroy them before the time of ripening. The pods swell at the maggot-infested spots, and ripen and wither also earlier than those which are uninfested, and burst open, and the larvæ fall to the ground, where they change to pupal state. In about ten days a swarm of little Gnat Midges make their appearance, and these again lay eggs in the pods, which are to be found at the upper part of the stalks of Rape or other cruciferous plants. In the province of Groningen, in the Netherlands, I have repeatedly seen the Gnat Midges to be very injurious to the Rape. Means of prevention scarcely appear to be applicable." †—(J. R. B.)

* "Erste Längsader dem Rande sehr genähert." For full description of imago see 'Fauna Austriaca: Die Fliegen (Diptera),' of Schiner, vol. ii. p. 374; and also 'Praktische Insektenkunde,' of Taschenberg, pt. iv. p. 8.

† See 'Tierische Schädlinge und Nützlinge,' von J. Ritzema Bos, p. 588.

There is another species of Gnat Midge, the *Cecidomyia* (*Diplosis*) *ochracea*, Winn., of which the maggots do mischief somewhat similarly to the above to the seeds and pods of Rape. But the Cecidomyias sent me were certainly *not* of this species, as these are of a clay-yellow colour, and are mentioned by Herr Schiner as turning *lighter after death*, whereas mine (as above mentioned) *had turned black*.

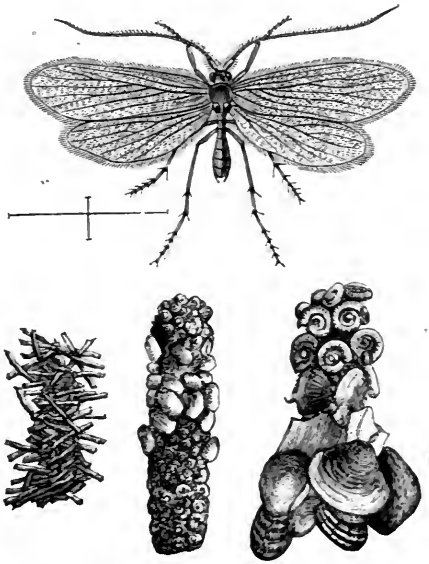
It would be of great interest to identify this attack with certainty, and I should be much obliged to correspondents who, when they see seed-pods of Turnip, Cabbage, Rape, or Mustard becoming mis-shapen and bursting open, would let me have a few specimens before they have arrived at the bursting stage.

There appears to be great similarity in this part of the damage between that caused by the *Cecidomyia brassicæ* maggots and those of our very well-known little Turnip Seed Weevil, *Ceutorhynchus assimilis*. This little grey weevil is found very frequently on the blossoming tops of Turnip, Mustard, or allied plants, doing mischief, along with the *Meligethes*, the Turnip-blossom Beetle, before the maggots begin their work of destruction within the formed pods. Then though, as noted by Mr. Sim, and mentioned also by John Curtis, some of the maggots may escape through a little perforation, yet they do damage wholesale by causing the bursting of the pod, and I should greatly like to have some of the still unopened pods, that I might see for myself which kind of maggot escaped, and perhaps be able to breed the *Cecidomyia* for identification of species.

WATERCRESSES.

Caddis Worms, larvæ of **Caddis Flies** or **Water Moths.**

(Trichoptera.*)



Mormonia nigromaculata.—Water Moth, magnified, and lines showing natural size (after Westwood); Caddis Worm "cases" of *Limnephilus flavicornis*, magnified.

One of the first observations sent me in 1896 was a report forwarded on January 22nd regarding serious loss which was being caused to a market gardener by attack of "Caddis Worms" to his Watercresses.

These larvæ, which, with hardly any exceptions, are aquatic, live in cases, whence they take their name of Case or Caddis Worms. Three different forms of these, belonging to the larva which presently turns to the very common Caddis Fly, or Water Moth, *Limnephilus flavicornis*, Fab., are figured a good deal magnified; the expanse of the fore wings of *L. flavicornis* is from one inch to an inch and a quarter.†

* This order is limited to about one hundred and twenty-seven species very similar in their habits as aquatic larvæ, but of which many are undescribed, therefore I have only given above the popular and scientific name of the order.

† These figures I beg to acknowledge with thanks as copied from plate ii. of 'Trichoptera Britannica: a Monograph of the British Species of Caddis Flies,' by Robert McLachlan (Trans. Ent. Soc., 3rd Series, vol. v.), of which sometimes separate impressions are still occasionally obtainable. In this valuable work, the reader will find full descriptions of the Caddis Flies, and also useful information regarding such of the larvæ as were available for examination,—the formation of their cases, and the nature of the localities frequented.

For general purposes Caddis Worms may be described as long and nearly cylindrical, with scaly heads, furnished with strong jaws, having short teeth fitted for gnawing vegetable matter. The three segments next the head are leathery, and each bears a pair of legs. This part of the grub is exposed when in process of walking about by means of the three pairs of legs, the nine following abdominal segments remain in regular course within the case; and at the tail extremity are a pair of hooks, which help the grub in walking, or to fix itself where it may desire, as occasion requires.

The largest of the "worms" sent me, when removed from their cases, were five-eighths of an inch in length. The head of a more or less brown tint, marked in the middle with a darker somewhat Y-shaped spot, pointing backwards, and on each side a broad brown streak, each slanting backwards also, so as to meet at the back of the head, thus forming a V, of which the point was just behind the stem of the Y. The first segment behind the head was banded across with dark brown and a lighter tint; the next variable in amount of brown in the different specimens; the third segment with a few scattered spots on a paler brown ground. The three pairs of long claw-legs palish brown, darker above or outside; the body behind these segments pale, but marked on each side by a very clearly defined narrow dark line. The tail segments had a few long and strong black hairs; and the pair of hooks, of which the enlarged bases are placed one on each side of the tail segment, were of a brownish colour above. The power of these as a means of holding fast was very obvious by the manner in which they became accidentally attached to the finger.

Altogether, and speaking generally, as there are twenty-four species of *Limnephilus*, of which the larvæ of many kinds have not yet been described, it seemed to agree very well with that of "the common and generally distributed species of *L. flavicornis*, Fab." (See Mr. McLachlan's 'Monograph,' p. 33.)

Later on in the year, I was favoured by Mr. Richard Coe, from another locality, Weston Farm, Albury, Guildford, with a number of specimens of "cases," of which some account may perhaps be of interest. The first I examined was cylindrical, three-quarters of an inch long by three-sixteenths of an inch wide, and was formed of small irregularly-shaped bits of stone, or minute pebbles; those towards the tail extremity were the smallest, so that they might be described as mere grains, and were mixed at the opening of the case, at the caudal extremity, with a little vegetable matter, like dead and faded Duck-weed. Another "case," an eighth of an inch shorter, was similarly formed of little pieces of stone, or pebbles, but with no difference in size at the caudal extremity.

Besides the above there were two "cases," approximately half an

inch long, formed chiefly of Duckweed (*Lemma* sp.). Another, scarcely more than a quarter of an inch long, was of Duckweed on a foundation of (or mixed with) material like pale, short, very minute, round stems. Several of the "cases" appeared to be wholly of vegetable matter, partly of the very little roundish scale-like leaves (or more correctly "fronds") of Duckweed, which all of us who have to do with ponds or ditches know well in the sheets in which it usually floats on the water in summer (these patches being composed, in the case of one of the commonest kinds, of multitudes of little leaf-like plants, each only about one-eighth to one-fourth of an inch across, formed of a flat green frond, with a single root fibre hanging down from it in the water). Also there were small pieces of leaf material which, from the irregular shape of the edges, seemed very probably to have been gnawed from Watercress leaves.

The substratum (usually) of the vegetable "cases" was of short cylindrical pieces of very uniform appearance, and apparently of roots of the Duckweed. These were laid very prettily side by side,—several laid together in one direction, and several together crossing their ends in another direction, like ornamental cane-work.

The grubs inside some of these were active, and the serviceableness of their long legs in helping them to progress by lapping them over each side of a blade of grass was very observable. In making their way where there was nothing to hold by,—as, for instance, when on the back of my hand,—I noticed the grub made use of its jaws as a partial help to drag itself on by.

The Caddis "cases" may be made of any material which lies conveniently at hand for the grub to spin together for its shelter; the prettiest form is that made of small shells. Within these "cases" the larva turns to the pupa condition, in which state they leave the now useless house a little before turning to the perfect Caddis Fly, or Water Moth. In an instance noticed by Prof. Comstock,* the time required for the insect to expand its wings and take its first flight was scarcely more than one second:—"The instant the creature was free from the water, its wings expanded to their full size, and immediately it flew away several feet."

The perfect insects, perhaps best known as Water Moths, have four membranous wings, turned well down at the sides when at rest; these more or less hairy, with few cross veins; legs long; mouth parts rudimentary; antennæ hair-like.

The eggs are laid in gelatinous masses, said to be retained for some time at the extremity of the body, and then attached to some water plant.

* See 'Manual for the Study of Insects,' by J. Comstock, Professor of Entomology in Cornell University, Ithaca, New York, U.S.A. 1895.

The figure (p. 153) is given just to show the general appearance of the perfect insects of this small order of Trichoptera, and is one of the genus *Mormonia;* but for general practical purposes, the Caddis Worms and Caddis Flies are too well known, and especially to fishers, to need description.

In reply to the notes sent me on January 22nd regarding the loss being suffered by a Watercress grower in Hampshire from what proved on examination to be Caddis Worms, I suggested that a greater amount of fish in the water would probably reduce the amount of the Caddises, and received the following note, showing the destructive powers of the grubs, and likewise that in this case the increase of birds which specially fed on the fishes which had previously held the water grubs in check, was at the root of the mischief:—

"January 27th.—I have just returned from a visit to the man's Watercress beds. Three-quarters of the area of them have been eaten, and the poor fellow is in trouble as to how he will be able to meet his rent of £20 for the half an acre. He tells me that as soon as certain flies appear these insects disappear. I have advised him to get some trout; his reply was, 'there were plenty of trout till the herons came.'"

As for local reasons it appeared that the presence of the herons was irremediable, and the grower's lease terminated in the course of the year, nothing further was requisite in this instance; but the following notes, which were kindly sent me, on April 30th, by Mr. Richard Coe, of Weston Farm, Albury, Guildford, give some very useful information as to treatment for getting rid of Caddis-attack, or keeping it in check.

Prevention and Remedies (from Mr. Richard Coe).—"The pest you name, commonly called 'Cads' in this locality, gives us much trouble every season, though sometimes more than others. This year there is rather less than more of the nuisance.

"Shrimps* are also very numerous, but with quick-lime can be effectually dealt with; not so the Caddis Worm. Whenever we find a bed of Cresses attacked, we clear away all the plants, drain off the water, and leave the bed perfectly dry for two or three weeks in the autumn, previous to the winter planting. If afterwards we find traces of the worm, we wait until the plants are well established, then we increase the volume of water, and swim the bed, and pass the backs of wooden rakes over the tops of the plants very thoroughly. This process brings the bulk of the worms to the surface, and they are let off down stream with the surplus water.

* Specimens of these were not sent me, so I cannot say which of the small freshwater existences they might be.

"We do not know of any preparation for the destruction of the worms without injury to the plants. When Shrimps are troublesome, quick-lime is very efficacious, and put into the incoming water kills the Shrimps without detriment to the Cresses."—(R. C.)

Our chief natural helpers against over-presence of Caddis Worms appear to be fish of various kinds. In Isaac Walton's long notes on the excellency of these grubs as baits, he mentions more especially three kinds "which are good indeed to take any kind of fish with float or otherwise."* From his descriptions of the "cases," it is obvious that it is the larvæ of the Trichoptera (*viz.* the Caddis Worms) which he refers to. But perhaps, relatively to the startling dimensions of one kind noted as about an inch long, "and as big about as the *compass of a twopence*," it may be well to mention that this measure is of a silver not a copper coin. I find on reference that "no authorized coinage of copper was struck till 1672, when halfpence and farthings of that metal were first made public money. . . . Pieces of a penny and twopence in copper were coined in the reign of George the Third." As Walton's five editions of his 'Complete Angler' were published respectively in 1653, 1655, 1664, 1668, and 1676, it is manifestly a silver twopence to which he refers, and a word as to the real size of the "case" may be of service.

Perhaps also it should be added that the term "May Flies" is not correctly applied to the Water Moths, or Caddis Flies, which develop from the Caddis Worms. The true "May Flies," or Ephemeridæ, with very few exceptions, only live as complete insects for a short time, or a few hours, and may be distinguished by their membranous wings, of which the foremost pair are the largest, and much netted with veins; and also by presence of two or three long and slender hairs, forming a tail-like appendage at the end of the body. These small flies are best known in the great flights in which they assemble towards afternoon or evening over or near water, where they afford excellent food to fish, and are much used as baits, real or artificial, but are quite distinct, entomologically, from the Water Moths of the Caddis Worms.

* See Walton's 'Complete Angler,' 1808, pp. 303, 304.

NOTE ON WARBLE PREVENTION.

In the foregoing observations I had not thought it necessary to make any further remarks on Warble-infestation, as the subject has now been almost yearly recurred to since 1884; and every year (including 1896) I have had repeated reports of the success of the very simple treatment advised.

I now, however (February 10th), find that the information is not so fully before all concerned as it ought to be, and therefore I insert a note of the methods which we find *perfectly serviceable*, taken from my four-page leaflet on Warble Fly (hundred and fortieth thousand), which I shall be happy to forward gratuitously to all applicants :—

"With regard to methods of remedy, there does not appear to be any difficulty of getting rid of the Warble-maggot easily and cheaply, when the Warble has 'ripened,'—that is, opened so far that the black end of the tail is visible. *Then* it may be destroyed cheaply and quickly.

"Squeezing out the maggots is a sure method of getting rid of them; but they may be destroyed easily and without risk by dressing the Warble with a little of McDougall's smear or dip, or (without noting by name the applications sent out by different manufacturers, whether Messrs. McDougall, or the Dee Oil Co., Messrs. Calvert & Co., or Messrs. Tomlinson & Hayward, or many others) any grease or mixture thick and tenacious enough for a little 'dab' of it, when placed on the opening of the Warble, to adhere firmly, and thus choke the maggot by preventing it drawing in air through the breathing-openings at the end of the tail, will answer well.

"Cart-grease, if not containing irritating additions, is a cheap and handy remedy, and acts well, especially if mixed with sulphur; so does lard or rancid butter mixed with a little sulphur, except in very hot weather, when it is apt to melt away. Mercurial ointment answers, if carefully used,—that is, in very small quantity, and only applied *once* as a *small* touch on the Warble; but where there is any risk of careless application it should not be used. Tar answers if carefully placed, so as to be absolutely on the hole into the Warble. *Bought cattle are often badly infested*, and need attention."—(E. A. O.)

INDEX.

WEST, NEWMAN AND CO., PRINTERS, HATTON GARDEN, LONDON, E.C

Yrs very truly
Eleanor A. Pomeroy

REPORT OF OBSERVATIONS

OF

INJURIOUS INSECTS

AND

COMMON FARM PESTS,

DURING THE YEAR 1897,

WITH METHODS OF

PREVENTION AND REMEDY.

TWENTY-FIRST REPORT.

BY

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PREFACE.

During the year 1897, as in the recently preceding years, we had not presence of any one special crop attack spreading widely over the country; but the ordinary infestations were mostly present, and in the case of orchard or fruit crops some of the infestations were unusually troublesome. In the absence of any generally prevalent drought in May, the general prevalence of orchard and Oak-leaf caterpillars, which caused such severe damage in the two preceding years, was little reported; but the weather influences of the continued mild winter are keeping presence of some of the crop attacks in activity to a degree which may require attention. From specimens sent me only a few weeks ago, maggot is present unusually early in the young Wheat plant; the very injurious caterpillars of the Small Swift Moth, which feed on different kinds of roots, are also at work; and in Clover I have more than usual presence of maggots of the "Clover and Pea-leaf Weevil" at the roots, and of Eelworm Stem-sickness. In the case of the Wheat and of the Stem-sick Clover, it would be so very desirable to be on the alert to apply (where needed) the requisite dressings, that I just mention what is going forward now, although the observations extend beyond those of 1897.

Amongst some of the special points of enquiry during the past year, more than usual attention has been given to imported insect infestations in Corn and Flour; and amongst Turnip attacks, the appearance of the Diamond-back Moth at various North British localities, rather late in the past season, suggests that it would be desirable to be on the watch presently to check the very first signs of presence of the pest.

Amongst fruit attacks, that of the newly observed species of Shot-borer Beetle, in addition to the destructive kind also

present in Plum wood, is of importance; so is the increased prevalence of the Strawberry Beetle; and the Black Currant Mite has been spreading its wasteful and difficult to counteract presence to a degree which, as will be seen in the "Appendix," is now being made the subject of special preventive experiment. An attack to Apple fruit has appeared in Devonshire of which it is impossible to speak with certainty, but which should be looked to. There is a possibility of it being that of a fly maggot, but also it corresponds minutely in damage done with that of a moth caterpillar, injurious to Apples, of which I have details from Dr. Fletcher, Entomologist of the Experimental Farms of the Department of Agriculture, Ontario, Canada.

The following list enumerates, as in preceding years, the greater part of the more important of the infestations regarding which enquiries were sent, arranged under the headings of the orders to which they entomologically belong:—

Beetles (*Coleoptera*).

Asparagus Beetle, *Crioceris asparagi*	Asparagus shoots.
Bacon Beetle, *Dermestes lardarius*	Meat, &c.
Bone and Leather Beetle, *Dermestes vulpinus*	Bones, Wood, &c.
Bean-seed Beetle, *Bruchus rufimanus*	Bean seed.
Chafer, Cockchafer, *Melolontha vulgaris*	Leafage and Grass roots.
,, Rose, *Phyllopertha horticola*	Flowers, leaves, and Grass roots.
Elm-bark Beetle, *Scolytus destructor*	Elm bark.
Lady-bird Beetles, *Coccinella septempunctata*	Aphides (beneficial).
Pine Beetle, *Hylurgus piniperda*	Pine bark and shoots.
,, Timberman Beetle, *Astynomus ædilis*	Pine bark and wood.
,, Weevil, *Hylobius abietis*	Young Pine bark, &c.
Plum Shot-borer Beetle, *Xyleborus dispar*	Wood.
,, ,, ,, *X. saxeseni* (=*xylographus*)	,,
Strawberry Ground Beetle, *Harpalus ruficornis*	Strawberry fruit.
,, ,, ,, *Pterostichus vulgaris*	,,
Weevil, Apple-blossom, *Anthonomus pomorum*	Apple flower-buds.
,, Granary, *Calandra* (*Sitophilus*) *granaria*	Stored grain, &c.
,, Rice, ,, ,, *oryzæ*	Stored grain, Rice, &c.
,, Pea, Clover, & Bean-leaf, *Sitones* (various species)	Leafage.
,, Turnip-seed, *Ceutorhynchus assimilis*	Seed in pods.
Wireworms (larvæ of various Elaters)	Roots of Grass and crops.

Butterflies and Moths (*Lepidoptera*).

Angoumois Moth, *Sitotroga* (*Gelechia*) *cerealella*	Stored Barley.
Codlin Moth, *Carpocapsa pomonella*	Young Apples.
Currant Magpie Moth, *Abraxas grossulariata*	Currant leaves.
Death's Head Moth, *Acherontia atropos*	Potato leaves.
Diamond-back Moth, *Plutella cruciferarum*	Turnip leaves.
Garden Swift Moth, *Hepialus lupulinus*	Roots of many crops.
Lackey Moth, *Clisiocampa neustria*	Orchard leafage.
Mediterranean Mill Moth, *Ephestia kühniella*	Flour, &c.
Privet Hawk Moth, *Sphinx ligustri*	Privet leaves.
Silver Y-Moth, *Plusia gamma*	Mangold leaves.
Surface Caterpillars, *Agrotis* of various kinds	Turnip and Mangolds.
Tiger Moth, *Arctia caja*	Garden leafage.

Two-winged Flies (*Diptera*).

Cabbage & Turnip-seed Gnat-midge, *Cecidomyia brassicæ*	Turnip seed.
Carrot Fly, *Psila rosæ*	Carrot roots.
Daddy Longlegs, *Tipula oleracea*	Roots of Grass, &c.
Forest Fly, Deer, *Lipoptera cervi*	Hair of Deer.
,, Horse, *Hippobosca equina*	Hair of Horses and Cattle.
Frit Fly, *Oscinis frit*	Oats and Wheat.
Gad or Small Breeze Fly, *Chrysops cæcutiens*	Men and Animals.
Gout Fly, *Chlorops tæniopus*	Barley stems.
Hessian Fly, *Cecidomyia destructor*	Corn stems.
Horse Bot Fly, *Gastrophilus equi*	Horses, internally.
Red Maggot (of) *Cecidomyia tritici*	Wheat ears.
Warble, Horse, *Hypoderma* (? sp.)	Hides of Horses.
,, Ox, *Hypoderma bovis*	Hides of Cattle.
Willow Midge Maggot, *Cecidomyia* (larvæ ? sp.)	Bark of Willows.

Sawflies, Bees, &c. (*Hymenoptera*).

Hornet, *Vespa crabra*	In old trees and wood.
Leaf-cutter Bee, *Megachile centuncularis*	Leaves.
Oak Apple (root form), *Biorhiza terminalis*	Oak shoots and roots.
Oak Spangle Galls, *Neuroterus lenticularis*	Oak leaves.
Sawfly, Apple, *Hoplocampa testudinea*	Young Apples.
,, Corn, *Cephus pygmæus*	In Wheat stems.
,, Pear, *Eriocampa limacina*	Pear leaves.
,, Pine, *Lophyrus pini*	Pine leaves.
Sirex, Giant, *Sirex gigas*	Pine timber.

Aphides, Scale Insects, &c. (*Homoptera*).

Apple-suckers, *Psylla mali*	Stems of blossom buds.
Beech-bark Felt Scale, *Cryptococcus fagi*	Beech stems.
Cabbage Aphis, *Aphis brassicæ*	Cabbage leaves.
,, Powdered Wing, *Aleyrodes proletella*	,,
Mussel Scale, *Mytilaspis pomorum*	Apple and Pear bark.
Spruce Gall Aphis, *Chermes* (*pini*) *abietis*	Galls on Spruce Fir.

Various other insect infestations were present, as of the Lesser Earwig, and also the Common Earwig, which had been previously reported Locusts, as an imported infestation in Lucerne, also gave some trouble; as did also the spread of the small striped Cockroach, variously known as the German Cockroach, and (in the United States of America) as the Croton Bug. Numerous other kinds of insects, economically injurious as affecting woodwork, clothes, carpets, furniture, and linen while bleaching, &c., but not coming under the head of agricultural pests, were also the subject of enquiry.

Amongst different kinds of injurious infestations not coming under the head of "Insect" life, various kinds of "Mites" (which are classed in the order *Acarina*) were more than usually troublesome; and far before them all in importance was the constantly increasing spread of the *Phytoptus ribis*, the "Black Currant Mite," to which I have been giving all the attention in

my power, both personally, and by continental and home correspondence. The very similar *Phytoptus* galls of the Nut, and the *Phytoptus* galls which much resemble blunt-pointed nails red or green in colour standing upright on Lime leaves, were more than usually noticed. Eelworm presence was also worse than usual in respect of causing Tulip-root in Oats, and, as observed above, the mischief continues still in Clover.

From various causes, the correspondence during the past year, which amounted approximately to about three thousand letters received, has been larger than in any preceding season; but by special arrangements I kept it as steadily in hand as I was able, and I trust that if any enquirer was not at once attended to, he will kindly accept the above as the reason.

Independently of insect matters, one chief point of interest of the year was the necessity of attending to the disastrous losses caused by the literally overwhelming amount of prevalence of one species of bird—the House Sparrow, *Passer domesticus*. I may mention that the leaflet compiled by myself (of evidence of the harm caused), with the valuable co-operation of Mr. Tegetmeier (Member of the British Ornithologists' Union), has met such a large circulation (*gratuitously, as it is still continued*) that about 28,000 copies have been distributed at agricultural and other centres in this country, and especially by our parish clergy, also (officially) in most of our Australasian colonies, where the hap-hazard introduction of this bird has caused such boundless mischief. A mass of information comprised in many hundreds of letters to myself gives valuable evidence of the losses caused by this bird, and the documents are preserved for possible future publication.

Once again, as in previous years, I have to acknowledge with grateful thanks the important assistance received in my work from almost all our leading agricultural journals, as well as from many on more general subjects; and my best thanks are also due for the exceedingly liberal donations of valuable publications of which I am very frequently in receipt.

Of the illustrations in my present Annual Report I beg to acknowledge, with thanks, those at pp. 10, 21, 48, 53, 104, 120, and 126, as being by permission of Messrs. Blackie & Son, of Glasgow; the Magpie Moth with closed wings and caterpillar

accompanying on p. 28, and the *Sirex gigas*, p. 69, are figures of which I was permitted the use from the 'Gardeners' Chronicle' set; the others (excepting where acknowledged accompanying) have mostly been drawn expressly for my own publications, and of these about eight now appear for the first time.

The portrait, inserted by request, is from a photo by Messrs. Elliott & Fry, Baker Street, W.

For myself, I hope that I may continue, so long as is wished, to give every attention in my power to such enquiries as may be addressed to me; and I can truly say that I should be both proud and thankful if I could hope to at all lessen the losses to our national agriculturists and fruit-growers by destructive and yet, if attended to, often remediable infestations of their crops.

ELEANOR A. ORMEROD, F.E.S.

Torrington House, St. Albans:
February, 1898.

List of Injurious Insects, &c., noticed in this Report.

NOTES OF OBSERVATIONS

OF

INJURIOUS INSECTS

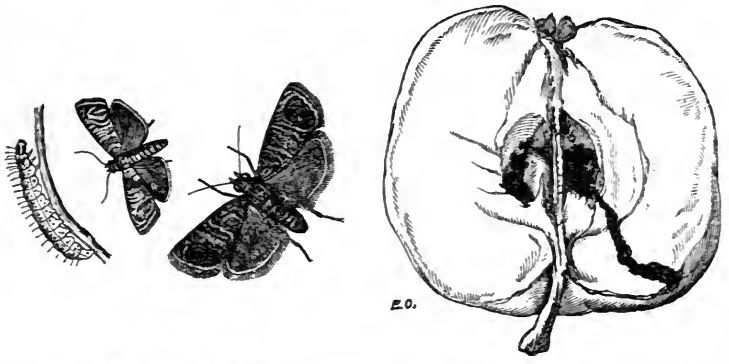
AND

COMMON CROP PESTS

DURING 1897.

APPLE.

Codlin Moth. *Carpocapsa pomonella*, Linn.
Apple Sawfly. *Hoplocampa testudinea*, Cameron; *Tenthredo testudinea*, Klug.



CARPOCAPSA POMONELLA.—Moth, nat. size and magnified; caterpillar; injured Apple.

DURING the past year, severe complaints have been sent from various places as to Apples being, what is termed, "maggotty"; and some part of the losses appear to arise from growers not being sufficiently aware of the differences in appearance, and also in place of winter shelter, between the caterpillars of the Codlin Moth and those of the Apple Sawfly.

The caterpillars of the Codlin Moth crawl to the trunk of the Apple tree, and there they shelter themselves in crevices of the bark, where

they spin a cocoon or web covering, in which they go through their changes; whilst, on the contrary, the caterpillars of the Apple Sawfly go down into the ground, and there, at a depth of two, three, or four inches (or even, if the soil is very friable, at a depth of seven inches), they form their cocoons, from which the Sawfly comes out at the time of the Apple flowers in the following season.

Consequently on this difference in habits, much good time and labour is apt to be more than thrown away in scraping and dressing the Apple tree trunks to get rid of Codlin Moth infestation, whilst all the while the caterpillars of the less known Apple Sawfly infestation may be lying unharmed close by beneath the surface of the ground ready to develop and start new attack with the opening of the next season's Apple blossoms.

The caterpillars of each of the above kinds are so far similar both in size and shape that, without careful examination through a magnifying-glass, it is very easy to mistake one for the other; but, when closely examined, it will be seen that the caterpillar of the Codlin Moth has *four pairs of sucker-feet beneath the body*, whilst the caterpillar of the Apple Sawfly has *six pairs*. By this difference in the number of the sucker-feet, and also by a very disagreeable scent, much like that of a plant-bug, or of a common bed-bug, the caterpillar of the Apple Sawfly may be distinguished from that of the Codlin Moth.

The history of both of the above infestations has been given at length in my Annual Reports,* but the following notes of the chief points are now given together for convenience of comparison where there is doubt as to which of the attacks is present.

The main points of the history of the Codlin Moth infestation are as follows. The moths come out about the time of the opening of the Apple blossoms, and when the blossom-leaves have fallen and the fruit is beginning to set, the moth lays her egg at the eye of the little Apple (that is, at the end opposite the stalk). Commonly only one egg is laid, but sometimes two or three may be laid; and also they may sometimes be laid by the stem of the young Apple, or on the cheek.

The maggot hatches in about a week or ten days, and gnaws its way into the Apple, where its presence is shown by the dirt thrown out at the eye of the Apple, or at the opening of a passage gnawed by the grub through the young fruit to enable it to throw the pellets of dirt out which could not be got rid of by forcing them through the small entrance burrow. It then feeds in the centre of the fruit, piercing the core, and injuring the "pips," and consequently the Apple falls. This is about four weeks after the maggot has hatched. If the maggot is still in the fruit when it falls, it leaves the Apple and

* For Codlin Moth, see 'Twentieth Annual Report,' pp. 1–9; for Apple Sawfly, 'Fifteenth Report,' pp. 1–5, and 'Sixteenth Report,' pp. 10–17.

crawls to a neighbouring tree, and when it has found a convenient crevice in the bark, it enlarges this so as to form a small chamber, where it spins a white cocoon or web over itself, and turns to the chrysalis state, from which, in ordinary course, the moth comes out at the time of the flowering in the following spring. Just possibly it may come out in about a fortnight; but as a general thing it is considered that in this country the moth is only single-brooded. Sometimes, instead of falling with the Apple, the caterpillar leaves the fruit, and lets itself down by a thread, or sometimes it creeps from the fruit along the branches to the trunk; but in whatever way it may leave the Apple, in ordinary circumstances it creeps to the trunk, and spins its shelter as above mentioned.*

The Codlin Moth (see figure, natural size and magnified, p. 1) is about three-quarters of an inch across in spread of the front wings. These are light grey, with many fine streaks and broader marks of a dark tint, and at the hinder corner is a large spot of reddish or gold colour, with paler markings on it, and a border of gold colour. The hinder wings are blackish.

The caterpillar (see figure, p. 1) is from about half-an-inch to three-quarters of an inch in length when full grown; whitish when young, later on more or less of a pinkish colour. The head, when young, is dark, later on lighter in colour; and the shield on the segment next the head similarly varies in colour with the age of the maggot, and so does the tail segment. It has eight little black dots, or warts, on each segment, so as to make two rows down the back, and one on each side; and it has three pairs of claw-feet (one pair on each of the three segments nearest the head); four pairs of sucker-feet beneath the body, and another pair of sucker-feet at the end of the tail.

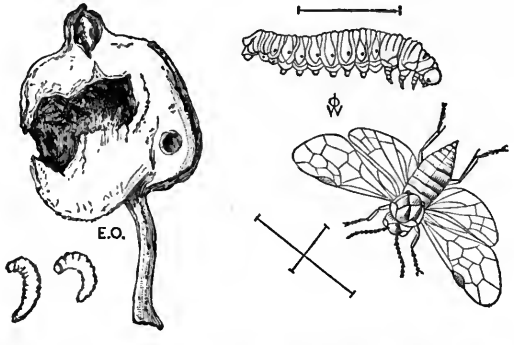
The attention of the reader is particularly directed to the number of the sucker-feet beneath the body being no more than four pairs, and also to the circumstance of the caterpillar, after leaving the fruit, going (save in quite exceptional cases) to the trunk of the Apple tree, as these are points by which the infestation of the Codlin Moth may be clearly distinguished from that of the Apple Sawfly, and the requisite measures of prevention be consequently applied.

Excepting in these two points mentioned above, it will be found that the method of attack of the Apple Sawfly closely resembles that of the Codlin Moth. Like it, the Sawfly (*Hoplocampa testudinea*) appears with the Apple blossoms, and the females may then be seen flying amongst the flowers, and may be caught in the act of egg-laying within

* An instance has been recorded by Mr. Frazer Crawford, in his exhaustive report on the Codlin Moth in South Australia, in which a number of the caterpillars which had let themselves down from Apples growing above a Raspberry bed sheltered themselves in the stumps of the old canes.

them, the exact spot for deposit (in instances recorded) being just below the calyx. In a series of special observations of the habits of these flies, in which they were first noticed on the 14th of May, the caterpillars were found to be hatching out, on the 28th of the same month.

The maggots are pale in colour, and when quite young, that is, when still only about an eighth of an inch in length, the head, and also the plate above the tail, is dark or black; but presently these are moulted off, and when the caterpillars are full grown, that is, about half an inch in length, they are mottled or creamy in colour, with the head pale chestnut, and the plate above the tail and the cross-band immediately preceding mottled with grey, and the three first segments (as in the case of the Codlin Moth caterpillars) have each a pair of claw or jointed legs. The next segment is legless; and then comes the marked distinction between the two kinds of attack under consideration. The fifth to the tenth segments of the Sawfly caterpillars have each a pair of sucker-feet, making six pairs in all, so that with the pair at the end of the tail (which is possessed by the Codlin Moth also), the Sawfly caterpillar has twenty feet in all, whilst the Codlin Moth caterpillar has only sixteen. A comparison of the figures of the two caterpillars will show this distinction clearly.



HOPLOCAMPA TESTUDINEA.—Female Sawfly and caterpillar, magnified, with lines showing natural size, after Prof. J. O. Westwood. Injured Apple and caterpillar, natural size.

The history of the attack of the Sawfly, given shortly, is that the caterpillars hatch in the very young (embryo) Apple, and as this grows, they grow, and feed within, and thereby cause much damage (see figure above), not only to the fruits in which they were hatched, but sometimes to other neighbouring fruits, to which they have the power of straying at pleasure. The injured Apples are not so regularly tunnelled as in the case of damage from Codlin Moth caterpillars. There are, or may be, tunnels, but also (see above figure) much of the inside of

the little Apple may be eaten away, thus causing a rough, blackened cavity with decaying surface.

When the caterpillars are full grown they drop to the ground, either inside the falling Apple or without it; this is found going on during July. They then go down into the ground and form cocoons, in which they spend the winter, and turn to the chrysalis (or pupal) state (which appears to be of very short duration), from which the Sawflies develop at the time of the opening of the Apple blossoms in the following year.

The Sawfly, *Hoplocampa testudinea*, scientifically, has the body yellow or reddish yellow beneath, and a large patch on the top of the head black, as also the top of the body between the wings, and the back of the abdomen; the other parts of the insect are chiefly yellowish. The wings are transparent, with the veins dark, or darker towards the base, and the patch on the front edge of the fore wings dark, but paler at the end nearest the tip of the wing. The length of the body about one-quarter of an inch.

Methods of Prevention and Remedy.—One very desirable method, which is equally applicable to both of the above attacks, is to have the young fallen Apples picked up as soon as possible and destroyed, or thrown where the grubs, if still inside the fruit, will be killed. A gentle shaking of the trees is also not at all an undesirable treatment, as it brings down fruit (which was about to fall) under supervision, and thus it can be cleared away at once.

But the point where remedial measures (for the two attacks, respectively) vary essentially is in the treatment requisite to get rid of the infestations in their *winter shelters*,—in one case from the bark of the Apple trees, in the other from the ground beneath them.

The plan recommended for clearing Apple Codlin Moth in caterpillar or chrysalis stage is to spread old sacks or anything that will catch the scrapings round the trunk of the tree. Then begin to scrape as high up as there is loose bark, and also scrape and clear out cocoons from crevices, and also from the forks of the tree. Scrape downwards until the ground is reached, and then gather up the scrapings and destroy them. After scraping the tree, a wash should be applied to kill any caterpillars or chrysalids that may have remained in crevices in the bark. For this purpose a wash with a basis of soft-soap, with any insect deterrent mixed with it, would be sure to do good, and the choice may be quite left to the grower. The above operation may be carried on at any convenient time during the winter.

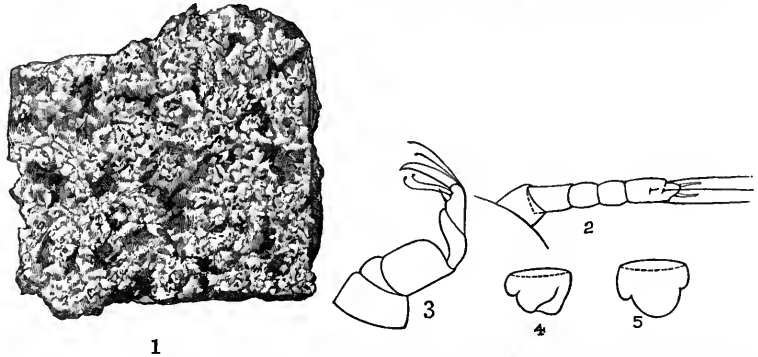
For getting rid of Apple Sawfly cocoons, where the nature of the soil or distance of the root-fibres from the top of the ground permits, such treatment of the surface, as by disturbance, or removal, or by dressing, would open the soil to bird action, or throw the cocoons under weather

influence in winter; or would destroy them by chemical manures injurious to insect life but not strong enough to hurt the root-fibres, are useful, and lime or (in quite small quantity) gas-lime of course suggest themselves, but it might be well to try nitrate of soda. Kainite at a rate of over half a ton an acre has been found useful in U.S.A. experiment on infested Pear orchard land in destroying Pear Midge maggot in the ground, and though the maggot of the Apple Sawfly is larger, and also is protected by a cocoon, still experiment as to the effect of the kainite would be worth while.

Many other preventive measures may be serviceably used with regard to both of the attacks, such as scalding baskets in which infested fruit has been transmitted, hand-picking the Sawflies when in reach, as when settling on the blossoms of espalier Apple trees; but these will be found in the papers on the respective attacks, to which reference is given in the foot-note on page 2. But the above condensed notes of the main points of distinction in habits and treatment on which preventive measures chiefly rest are given together as shortly and plainly as possible in order that growers troubled by "maggotty" Apples may be able to have the information at hand without further trouble in reference.

BEECH.

Beech-bark "Felt-scale." *Cryptococcus fagi*, Baerensprung.



CRYPTOCOCCUS FAGI.—1, felt-like infestation on bark, from life; 2, antenna of larva; 3, leg of larva; 4 and 5, stump-like legs of female, highly magnified, after figures by Karel Sulc.

On March 5th enquiries were sent me on the part of Lord Burton, of Rangemore, Burton-on-Trent, regarding a bark-infestation which

was doing great harm to the Beech trees in his woods at Rangemore. The pieces of Beech-bark, of which good specimens were successively sent me for examination, were almost entirely covered with a whitish coating of a flocculent formation (see figure 1, p. 6). This coating was formed of flattish irregular masses of various thicknesses, from the sixteenth of an inch, or even less, up to about three times that thickness, and thus formed, in some places, only a slight covering to the bark, but was commonly of an aggregation of little soft irregular lumps, with the dark bark showing here and there amongst them, and looking much as if badly mixed whitewash, with the lumps of lime not properly dissolved, had been thrown at the bark of the tree.

In this white coating I found the little orange Coccids, which secrete the felt-like* material, numerously present. The shape of these was scarcely discernible by the naked eye, as they are not as much as half a line in length; but when magnified, they could be seen to be almost globose in shape, orange or yellow in colour, and with soft bodies, sometimes lying singly, and sometimes in numbers near together.

In the supply of specimens, sent me on June 4th, I found Coccids numerously present beneath the white felt. These were of various sizes, the smallest were somewhat oval, or approaching to a cylindrical form, blunt at the extremities, the largest were almost spherical; they were mostly pale in colour, but some were of a reddish yellow. The spherical specimens were females; those that were somewhat narrowly oval were larvæ.

These "Coccids" belong entomologically to the great division of "Scale Insects," which do mischief by piercing into plant-tissues, and drawing away the sap by means of their suckers; but they do not, like many kinds (as the Apple-bark *Coccus*, for instance), form a scale over themselves in their mature stage, they are more nearly allied to the soft fleshy kind, commonly known as the "Mealy Bug"; and the infestation is of considerable interest as a forest insect pest, for, as will be seen from the following observations, it is both widely distributed in this country, and also, unless in situations where treatment can be applied, very hurtful to the infested trees.

In the first communication sent me (on March 5th) by desire of Lord Burton, from Rangemore, Burton-on-Trent, it was mentioned as "the infestation which is destroying all the Beech trees in the woods here."

In a further communication by Mr. W. Bennett, from Rangemore, sent on April 3rd, he mentioned that the specimens then sent were from a tree that was to all appearance dying from the attack, but had

* As this Scale insect does not appear to have any English name at present, I have suggested Beech-bark "Felt-scale," as noting the locality and the appearance of the infestation.

not been treated in any way. Some other trees which had been twice washed during the winter with an insecticide were found to be much cleaner, and it was considered that another similar washing would nearly free them.

In a letter with which I was favoured on April 28th by Dr. William Somerville, Professor of Botany at the Durham College of Science, Newcastle-on-Tyne, he remarked:—

"Thanks for calling my attention to *Cryptococcus fagi*. The insect is very common hereabouts, and, in fact, in most parts of the country. It does a lot of damage too, and I doubt if badly infested trees ever properly recover, unless artificially assisted by dressings similar to those used for the American Blight."

The following note from Mr. J. Eardley Mason, written from Lincoln on April 22nd, shows this Beech-bark infestation to be found near Leeds. Mr. Eardley Mason noted:—

"It was in 1885, as near as I can remember, that in a wood at Headingley, or very near to the boundary of that parish, which is a suburb of Leeds, I noticed splashes of 'whitewash' on Beech trunks. Closer examination showed that these splashes were of insect manufacture. I cut off some, and sent them to Mr. J. W. Douglas, who, in acknowledging the receipt, gave me the name."

Other notes of appearance* mention the attack being noticed in Dalkeith Park (about six miles from Edinburgh), also in the Ravensworth Woods (near Gateshead, Co. Durham), and on Beech trees near Exeter, which altogether give a wide area of distribution in this country.

It has been known under many synonyms, as *Coccus fagi*, of Walker; it was subsequently considered by Dr. Signoret that it should be placed in the series of *Pseudococcus*, where it is accordingly placed by Mr. J. W. Douglas in his paper, referred to below, published in 1886; and more recently, after consultation between Prof. Karel Sulc, of Prague, and Mr. Douglas, it has been placed in the genus *Cryptococcus*, Douglas, species *Cryptococcus fagi*, Baerensprung.

In the paper by Mr. Douglas (see note for reference), he remarks, under the heading of *Pseudococcus fagi*, Baerensprung:—

"At the end of May last, at Blackheath, I saw on the trunk of a Beech tree some forty or fifty years old many white spots of flocculent matter protruding through small cracks in the dry black bark, forming mostly isolated, short, stout tufts or streaks, but sometimes several of them were close together, making conspicuous patches. I cut out some of the bark so affected, and found that the flocky matter extended under the free edges of the cracks, as it were into the dead or dry

* For authorities, see paper by J.W. Douglas, F.E.S., on "Some British *Coccidæ*," Ent. Mo. Mag. for December, 1886.

bark, and there were in each instance from four to eight fat, yellow, oval Coccids lying close together, but each separately in a kind of cell formed in the compact felt-like cottony flocks.

"On July 16th I again visited the tree, and cut out several of the white patches, and found in each eight to twelve pale yellow Coccids closely packed together in the felt-like cotton, and surrounded with eggs. Under the microscope I saw the Coccids were just mature."—(J. W. D.)

The fullest and most recent description of the insect up to present date is that given by Prof. Karel Sulc in his treatise, mentioned below,* under the present name of *Cryptococcus fagi*, Baerensprung, from which I extract some of the main points. Prof. Sulc describes the female as elliptical, almost subcircular, canary yellow colour, and with the marking of the segments on the fore part of the abdomen hardly discernible; simple reddish eyes; antennæ atrophied, so that they form a stump only, bearing two to four short hairs. First and second pairs of legs wanting; of the third only a papillar or saccate stump remaining (see figures 4 and 5, p. 6).

The "first larva" is elliptical, reddish yellow; eyes distinct, reddish brown; antennæ (figure 2, p. 6) five-jointed, third and fourth joints shorter than the others, and equal in length. Legs (figure 3, p. 6) strong; coxa large; trochanter wedge-shaped, with a rather long hair; femur massive, as long as tibia and tarsus together (*i.e.* thigh massive, as long as shank and foot.—E. A. O.). Abdomen distinctly segmented.

Length of the adult female 0·47 mm., breadth 0·44 mm. Male unknown.

In the observations given by Mr. Douglas on this infestation (previously referred to), under the synonym of *Pseudococcus fagi*, Baerensp., he also gives a technical description of the Coccid, with the addition that it possesses "a short appressed covered rostrum, of which the brown tubular end was free, and turned at a right angle, and from this end projected an extremely fine blackish seta." He also mentioned that, at the date of observation, July 16th, he "saw in several instances the actual extrusion of eggs,—large, pale yellow, oval, and transparent."

From the minute size of the insects, as well as the adhesion of the flocculent surroundings, and likewise from their being unicolorous, there is great difficulty to any but highly skilled manipulators in securing specimens for figuring, and I wholly failed in the matter; but

* See "Studie o Coccidech" ("A Study of Coccids"), by Karel Sulc. F. Rionace, Prague, 1895. 8vo, pp. 1–27, 3 plates. This publication is an extract from the Transactions of the Inst. for Comp. Anat. and Zoology, Bohemian Univ., Prague, and is issued separately, with English translation accompanying.

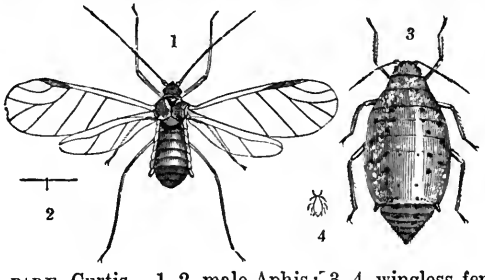
whilst preparing this paper, I was favoured by Mr. Robert Newstead, of the Grosvenor Museum, Chester, with a sight of his beautiful figures, drawn from life, of this Scale insect, *Cryptococcus fagi*, prepared by him for one of the illustrations of his 'Monograph on *Coccidæ*' for the Ray Society. These figures give full and excellent representation of the upper and under side of the female *Coccus*, with all details; and likewise of the larva, showing the narrower form, the six legs in position, and many additional much-magnified figures, which will be of the greatest service to future students of this infestation.

In regard to methods of prevention and remedy, probably syringings or washings of water would be useless, as in some experiments which Mr. G. B. Buckton, F.R.S., was good enough to try for me on specimens of infested bark, he found that the felt-like or "furry" matter was quite insoluble in water. Probably soft-soap washes, with a little sulphur, or a little mineral oil of some kind, incorporated in them, would clear the infestation well, for they would be prevented by the "felt" from running off at once, and thus remain to destroy the contained insects or eggs.

But here, as with other forest insect attacks, it would be impossible at a paying rate to apply dressings to large areas of infested woodland. Small numbers of trees, or trees which for any particular reason it was wished should be preserved, might in all probability be cleared from the attack, but further than that, remedial measures do not seem available.

CABBAGE.

Cabbage Aphis. *Aphis brassicæ*, Linn.; *Aphis floris rapæ*, Curtis.



Aphis floris rapæ, Curtis.—1, 2, male Aphis; 3, 4, wingless female—natural size and magnified.

On July 23rd specimens of very bad attack of Cabbage Aphis were sent me by Mr. Samuel Fraser, from the Cheshire Agricultural and

Horticultural School at Holmes Chapel. Of these, Mr. Fraser wrote:—

"I should feel much obliged if you could give me any information about the enclosed 'Aphis' on the Cabbages. The last two or three days have been sultry and close, and the Aphis have increased wonderfully. Where one Cabbage was attacked two days ago, a dozen all round it are attacked now. They cover the leaves completely in some cases, and render them white, thus checking growth, and nearly killing the plant; the very luxuriant ones are not attacked. The piece of land worst infested is where we had some Potato-pits last winter."—(S. F.)

The specimens sent me covered the Cabbage leaf almost solidly for a space of about six inches in length, up to as much as one and a half in breadth, and the aphides were packed together, even to being one on the other, besides more scattered presence of attack ranging up to about seven inches in length by four in breadth.

The youngest aphides were yellowish in colour; the older specimens, in the condition answering to the pupal state (of which there was the largest proportion), were dull or dirty greenish, much corrugated across, and with black or grey-black wing-cases. The females were green in the abdomen; head and most of the body between the wings black. Very few winged females were present when the specimens reached me, but on opening the box, where I had put them aside, a few days afterwards, the great number of winged females which had developed was very observable.

This species is the same as the *A. floris rapæ*, of Curtis, of which he remarks ('Farm Insects,' p. 70) that it "is readily distinguishable by its white dusty appearance, with which both sexes are thinly coated," and the white dusty appearance was very noticeable in the masses of specimens sent me.

In the hollow formed by the central vein of the Cabbage leaf there were balls of a white formation, which, on examination with a magnifier, proved to be globules of moisture, apparently exuded by the aphides, and covered with white powder from their own mealy coating, which prevented the drops running together. On crushing some of the drops on a piece of blotting-paper, the moisture spread about on the paper, and the white mealy deposit was in sufficient quantity to remain noticeably on the surface.

The description of the wingless female* is:—"Body long oval, plentifully covered with a mealy coat, both on the upper and under sides. When this is removed by a drop of spirits of wine, the body below is greyish green, with eight black spots ranged down each side of the back, which increase in size as they approach the tail. Antennæ

* See 'Monograph of British Aphides,' by G. B. Buckton, F.R.S., vol. ii. p. 34.

green, with black tips, shorter than the body. Eyes and legs black. Cornicles very short and black. Tail also small and black."

The male of *A. floris rapæ* is described by Curtis as dull pale green, dusted with white; eyes, head, disk of the thorax, and abdomen varied with black; legs ochrey, apex of thighs, shanks, and feet black (see figures 1 and 2, p. 10).

This species is a distinct one from what may be called the common Turnip Leaf Aphis, now known as *Rhopalosiphum dianthi*, Schrank, which is not only a severe pest at times to Turnip leafage, but also is to be found very generally distributed on garden and field crops; but, as mentioned in Mr. Buckton's work (quoted above), the "confusion in the synonymy of this Aphis is very great."

The "Cabbage Aphis," *A. brassicæ*, feeds on a good many kinds of plants besides Cabbage, but to this it is especially destructive from the enormous quantities in which it infests not only the upper, but the lower sides of the leaves.

Prevention and Remedy.—All measures of preparation of ground and of cultivation generally which are calculated to push on good growth are of service, not only in keeping up the strength of the plants when suffering from loss of sap drawn away by the suckers of the aphides, but also by making the plants themselves less suitable for multiplication of the aphides. It has long been found that where plants are stunted from drought, or other circumstances which keep back growth, that increase of the "Plant-lice" takes place more rapidly, and it will be noticed that in Mr. Fraser's observations, p. 11, he especially mentions the wonderfully rapid increase of the aphides after two or three days of remarkably close and sultry weather.

In field Cabbage growing, such plentiful manuring is a regular treatment that nothing more seems wanted on this head; but on a smaller scale, attack might be lessened by more attention beforehand to such thorough cultivation as would let the roots go down to their full natural depth, and thus save them from being dried, and not drawing up requisite supplies in temporary droughts. Amongst special manurial applications kainite has been recommended, but I have not definite record either of quantity or effects; but nitrate of soda would be an excellent application from its rapid action when melted into the ground by return of rain after drought, or by artificial watering, where this could be applied.

In garden cultivation, applications of liquid manure would be very useful, and even water alone plentifully applied is useful both in refreshing the plants, and washing off some of the lice.

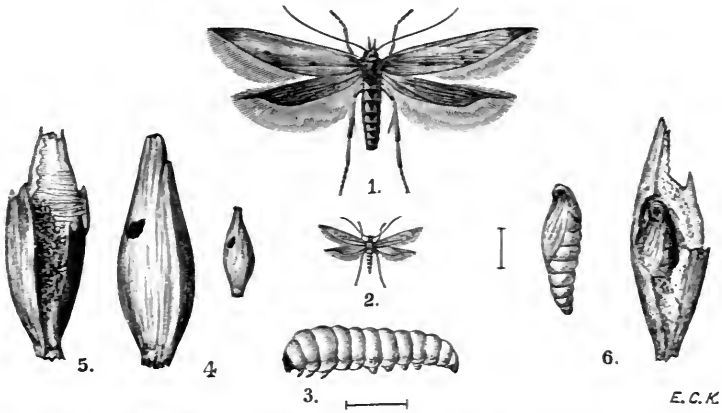
For dry dressings, soot, or lime, or any of the usual mixtures used for similar purposes, do some good; but where "kerosine emulsion"

(for recipe, see Index) can be mixed, this would probably do more good as a washing or syringing than any other application. There is, however, so much difficulty, both here and in America, where it is so greatly used, in permanently blending the soft-soap wash and kerosine, that (as unless this is done properly, much damage is caused to leafage) I have found a very similar mixture sold by Messrs. Morris, Little & Son, of Doncaster, to be a good substitute. This is very similar to the American emulsion in ingredients, but is sold ready mixed in semi-fluid state, so that it only needs diluting, and I can speak from personal experience as to it answering well where I have known it to be used for getting rid of Aphis on Cabbages.

Some amount of difference in the spread of attack may be made by burning infested plants, and also by destroying wild plants on which the "Plant-lice" are feeding, as, for instance, "Charlock" (*Sinapis arvensis*) and "Shepherd's Purse" (*Capsella bursa-pastoris*); but these arrangements are hardly practicable except in garden cultivation or on small plots.

CORN.

Angoumois Moth; **Fly Weevil** (U.S.A.). *Sitotroga* (*Gelechia*) *cerealella*, Oliv.



SITOTROGA CEREALELLA.—1 and 2, moth, magnified and natural size; 3, caterpillar, magnified, and line showing natural length; 4, pierced grain, natural size and magnified; 5, grain with frass, magnified; 6, chrysalis in grain, and removed, magnified, and line showing natural length. From North African Barley.

The grain infestations of the "Angoumois Moth" have long been known as the cause of serious losses in France, and in other countries

where the warmth of the climate suits it for propagation; and in more northerly localities bordering on infested areas, where occasional variations in temperature may allow it to establish itself temporarily, or breeding may be continued on grain in warm stores, the possible appearance of this attack, by importation or otherwise, is one of those regularly watched for by those who are connected with prevention of damage from injurious insects.

The moths much resemble what are commonly known as "Clothes Moths," and the mischief is caused by the maggots, which hatch from the eggs laid by the moths on matured corn, penetrating into the grains, and clearing out the contents, so as to reduce them to mere husks, emptied of everything excepting the dirt resulting from the feeding of the maggots, and some remains of chrysalis-cases, web-cocoons, or moulted skins.

The moth takes its name from Angoumois, a province of France, where it was observed as being destructive so far back as early in the last century. From published records, the attack of the insect was known of in Europe (in this case to stored Barley in France) in 1736, but the moth is stated not to have been described until 1789.

In America it is said to have been recognized as early as 1728, and is considered to have been "unquestionably imported by the early settlers of Virginia in their supplies of Wheat brought from the old country. From this centre it has spread in all directions through the country, but more extensively towards the south than towards the north, since it does not thrive in a very cold climate." *

I do not find it mentioned as an *English* pest, either by Kirby and Spence, or by John Curtis in his excellent description of the infestation in 'Farm Insects'; and in the paper on this insect given by Mr. C. G. Barrett, F.E.S., † he mentions that in his "own experience the moth has been taken in plenty about the granaries of the docks at King's Lynn, yet no instance of its spreading abroad among the barns or grain-stores of Norfolk was, so far as I can ascertain, ever observed."—(C. G. B.)

The specimens from which my own observations were taken were from a cargo of Barley imported from North Africa, which proved to be infested to such a degree as to attract attention of intending purchasers, and of which samples were sent me for certainty of the nature of the attack.

On the 4th of February in the past year (1897) specimens of

* See "The Angoumois Moth, or Fly Weevil," by L. O. Howard. 'Insect Life,' Periodical Bulletin of the United States Department of Agriculture, vol. v. p. 325.

† See Ent. Mo. Mag. for January, 1897, p. 9.

Barley were forwarded to me by a Liverpool firm,* with the following observations:—

"We enclose a few grains of North African (Tripolitan) Barley, which you will notice show a small perforation. Although such grains appear among the Barley in quite infinitesimal quantities, yet some of our English maltsters are afraid to use the Barley (although considering it otherwise suitable) because they fear that the perforations indicate the presence or the possibility of weevils. Although we believe this fear to be entirely without ground, we venture, as the matter is one of considerable public interest, to ask your opinion,—(A) as to whether the perforation indicates weevil, or any danger of such developing; (B) as to the insect which causes the perforation, and if any eggs are left in the grain, whether same are likely to cause injury?"

The matter being obviously of importance, I examined every one of the Barley grains sent me by cutting them open and ascertaining the nature of the contents under a powerful magnifier, and found that the damage had been done, not by the maggot of any kind of true weevil or other beetle, but by the caterpillar of a very small moth, and investigation of other specimens (from which I was able to take the infestation both in grub and chrysalis state, and was also able to rear specimens of the perfect insect) showed it to be of the moth known under the various synonyms of *Sitotroga cerealella*, of Olivier, and also of *Butalis cerealella* and *Gelechia cerealella*, of the same observer. Popularly it is known for the most part as the "Angoumois Moth," although in America the name of "Fly Weevil" is still applied to it, as it was before the year 1791, not only to this infestation, but also to those of the Granary Weevils, *Calandra granaria* and *C. oryzæ*, which it resembles so much in its method of injury to the grain.

The mode of attack is for the female moth to lay her eggs, up to as many as twenty or thirty in number, singly or in lines and clusters (and especially along the longitudinal furrow) on ripened or nearly ripened corn whilst standing in the field; but egg deposit may also take place on stored corn in granaries, and from this cause, where temperature is suitable for propagation, a constant presence of the attack may be kept up.

Barley appears to be especially liable to attack, but Wheat is also subject to it, as well as other cereals, and likewise Maize, or Indian corn, as well as Buckwheat, and seeds of some other crops, in which it would only trouble us as an imported pest.

The eggs are red or orange red in colour, and from these the little whitish caterpillars, which at first are hardly thicker than a hair,

* I am requested, for trade reasons, not to mention the name of the firm; but I may further say that the infested cargo, regarding which enquiry came to me through their hands, was not shipped to themselves, but to one of our eastern ports.

hatch out in about from four to seven days, and proceed to bore into the grains, and feed on the material within them. In the case of Maize, it has been found that two or three or even more caterpillars may be found in one grain; but in the case of Wheat or Barley, or our other cereals, one maggot only is found in one grain kernel, and each kernel contains enough material to support its occupant until it is fully grown. Then, after gnawing a little round hole in the side of the grain as a way for escape when the change to moth condition has taken place, the caterpillar spins a web cocoon, which occupies a part of the inside of the emptied coat of the grain, the rest being occupied with its castings, or pellets of rejected matter, and in this web the caterpillar goes through its change to the chrysalis state (see figure 6, p. 13).

The moth (see figures 1 and 2, p. 13) is rather more than half an inch in spread of the fore wings; antennæ long and fine, appearing a little beaded when magnified; proboscis long, and very noticeable; the general colour of the whole insect, including in this all excepting the hinder wings (which are of a leaden grey), is of a light grey or somewhat ochrey tint, described by John Curtis as like "coffee and milk"; the specimens which I reared were of the yellowish tint. The fore wings, which are straight with a pointed apex, have some black markings (see figure), or some black atoms, sprinkled at the extremity, and also on the inner margin of the fringe, and the lower surface is of a rosy shining brown. The hinder wings are bordered with a long and delicate fringe.

The length of the caterpillar is about two- to three-eighths of an inch; the specimens which I measured after taking them from the North African Barley were only about a quarter of an inch long, and the grub thick-made for its length. The colour whitish, mouth parts of different shades of chestnut or of darker brown, and in the best living specimen two very fine lines of brown ran up the centre of the face from the lowest part. The pairs of claw-feet on the three foremost segments were very small, and when seen through a two-inch focus-glass appeared almost like mere pale-coloured claws; and the four pairs of sucker-feet beneath the body (viewed with the same power) were only just perceptible.*

* In the very interesting account given by Mr. C. G. Barrett, F.E.S., of the infestation of this moth, *Gelechia* (*Sitotroga*) *cerealella*, Oliv., in connection with Maize imported from the United States, he mentions that "the larva seems to be yellowish throughout. When full-grown, it is one-fourth of an inch in length, excessively sluggish, with extremely small head partially withdrawn into the second segment; legs and prolegs minute and obscure; body thick, excessively wrinkled; segments deeply divided. Head pale yellowish, with a brown spot on each lobe, and very small darker brown jaws. So stupidly inert as apparently to be fit only to lie in a cavity of the grain, and eat the starchy contents, packing away its excrement in white granules in the cavity behind it."—Ent. Mo. Mag. for January, 1897, p. 8.

In order to form a general idea of the amount of infestation that might be present in the sample of North African Barley sent me for examination, I tried the experiment of placing about a handful of the Barley in a bowl of water, stirring it well round in order that it might be all equally wetted, and noticing how much of the grain floated. The plan answered so well, that I should say it might be fairly trusted to as a guide to ascertain amount of infestation in suspected samples, for almost all the infested grains appeared to come to the surface.

When the grain is in its customary dry state, the little round maggot-perforation in the side may, from its exceeding minuteness, easily escape observation; but in the test by floating, the injured grains are much more readily noticeable, by reason of the moistened outer coat of the Barley swelling, and in its expansion showing the perforation plainly. With regard to *un*perforated grain, there is little observable (excepting to very careful touch) to show which is infested or otherwise, but when moistened the infested grains will be found to give way before pressure from a finger-nail, and thus, where attack is set up, show presence of the maggot which has destroyed the substance within.

In regard to some sort of estimate of amount of attack present in the sample sent me: on placing about six and a half ounces of the North African Barley in water, a few light grains immediately floated to the surface, and after leaving the Barley undisturbed for rather over forty minutes, I found about eight more grains had floated, and on disturbing the soaking grain thoroughly, I did not find that more infested grains worth mentioning came to the surface. Altogether the grains that floated amounted to about a table-spoonful, some of which were certainly infested, but I did not open them all.

In the short account of this infestation by Mr. F. H. Chittenden referring to its life-history in the United States of America, it is stated that in three weeks or more, according to season, the caterpillar attains maturity, and that the entire period from egg to adult state embraces in summer time about five weeks, and in colder weather considerably longer; but also that there is "an irregular development influenced by temperature." Observation is given that in the latitude of the district of Columbia, in an outdoor exposure, there are probably not more than four broods in the year, the insect hybernating as larva in the grain; but in a heated atmosphere there is a possibility of five or six generations annually. In the warmer climate of the south, where the insect can breed uninterruptedly throughout the winter, it has been estimated that as many as eight generations may be produced.*

* See "Some Insects which are Injurious to Stored Grain." Farmers' Bulletin, No. 45, p. 7. By F. H. Chittenden, Assistant Entomologist, United States Department of Agriculture.

In the more northerly localities, the mischief is much less important until, with increase of lowness of temperatures, the insect, even if transmitted, ceases to be able to establish itself.

In the case of the sample of North African Barley which I had the opportunity of watching, development of the moth did not take place, so far as I observed, until more than two months after receipt of the infested grain. On April 16th I noticed that some grains of the sample which I had received on February 4th or 8th appeared to be showing more perforation, and I netted them over, so as to prevent escape of any moths that might develop, and on April 20th I noticed the first specimen of the *S. cerealella* had appeared, and on moving the Barley I found another. I did not take the dates of other subsequent appearance, but one of the last, so far as I am aware, out of this sample of Barley did not appear until after May 19th.

The infested Barley, from which samples were sent me, "was harvested in May or June, 1896, was in store in North Africa until the following November, when it was shipped to ——,* where it now lies" (February 8th, 1897). My correspondents further remarked:—

"Although, as we have said before, it is almost invariable to find indications of the presence of the moth in the Barley as brought in from the fields in Tripoli or Tunis, yet it does not seem to be considered as destructive by the natives to any appreciable extent, although Barley is sometimes kept closed in silos in the dark for two or three years, so it would appear the insects do not increase very rapidly."

The points involved in the above observation as to how far development is influenced by temperature, amount of light, and also pressure from weight of grain preventing ingress of the moth for egg-laying, and egress of such moths as may develop in the stored corn, are of much practical importance, and I give some notes below, as though it may be reasonably conjectured from experience in other countries that we are not likely to be troubled with Angoumois Moth on standing corn in this island, yet as a stores' pest it may require attention.

Prevention and Remedies.—The point where this infestation is to be dealt with is in the stored grain. It is laid down by Dr. L. O. Howard, Entomologist of the United States Department of Agriculture, in the American observations, which are the fullest that we have on this insect, that it passes the winter only in the barns and storehouses. It will breed uninterruptedly generation after generation in stored Wheat. At the time of harvest the moth flies out from the granaries to the Wheat fields, and will lay its eggs on grains of Wheat in the

* Name of port omitted by request.

shocks. The larvæ are not destroyed in the threshing, and are carried in the grains to the granaries.*

The following notes by the entomologist to the New Jersey Agricultural College Experiment Station, and the New Jersey State Board of Agriculture, U.S.A., convey on the same points such useful practical information, that I quote the passage almost entire from Prof. John B. Smith's serviceable volume on 'Economic Entomology' †:—

"The insects sometimes lay their eggs upon grain in the fields, and when it is cut and brought into the barn, they continue breeding in the mow so long as it remains there. Corn-cribs frequently become infested, and the insects breed as long as the temperature remains mild.

"Where grain is threshed and bulked, the upper layers may be infested, but the insects are not able to get in very far, because the moth is unable to escape through any heavy layer, becoming worn out, and dying before reaching the surface. The insect is much more troublesome southward than it is to the north, where the cold weather checks breeding before it has an opportunity to do much damage; but in regions where the temperature in the barns is moderate throughout the winter, it frequently does great injury.

"The best remedy is threshing and bulking the grain as soon as possible, covering the bins to keep out the insects. If infection is noticed, it can be easily checked by evaporating bisulphide of carbon in a dish upon the surface. The vapour is heavy, and sinks through it to the bottom, effectually clearing out any insects that may be present. In corn-cribs, the bisulphide can also be used, but the crib must be temporarily closed by canvas or sheeting, so that the vapour may become effective before it escapes.

"It has been found by experiment that grain can be exposed to this vapour for a considerable time without losing in germinating qualities, but seed Wheat should be, if possible, kept free from such insects. . . . Open corn-cribs should be placed in such a way as to get the benefit of all the cold weather there is, and thus the multiplication of the insects will be checked so early that no serious damage will be done."—(J. B. S.)

It should perhaps be observed in passing, that in the above extract the word "corn" is used in the American sense, and is to be understood as Indian Corn or Maize; but the treatment is equally applicable to Barley, Wheat, or other of the cereals in which the "Angoumois

* See "The Angoumois Moth or Fly Weevil (*Gelechia cerealella*)," by L. O. Howard. 'Insect Life,' vol. v. p. 326. United States Department of Agriculture, Washington.

† See 'Economic Entomology,' by John B. Smith, Sc.D., p. 326. Philadelphia: J. B. Lippincott Company. 1896.

Moth" is more likely to be troublesome to us in this country than in Indian Corn, excepting when this comes to us as an infested import.

In regard to the amount of bisulphide of carbon to be used, this of course varies with the space to be treated, and good directions as to amount, method of use, and the great need of care in using the highly inflammable liquid, will be found in the paper by Dr. Howard on the "Angoumois Moth," before referred to ('Insect Life,' vol. v.). It is mentioned that when used in bins, a pound and a half to a ton of grain is an amount that has been recommended. "When used in a reasonably close room, or in a nearly empty bin, one pound of the bisulphide should be evaporated for every one thousand feet of cubic space; or in a space ten by ten by ten feet, one-third of a pound in each of three shallow vessels for a space of these dimensions. For a space ten by ten by twenty feet use two pounds in six vessels, . . . and so on. Make the room as tight as is convenient.* A good time to treat the grain is on Saturday afternoon. Place your pans of bisulphide in position, close the room up tightly before dark, and leave it closed until Monday morning. Then air the room thoroughly, and stir the grain to some extent. The vitality of the grain will not be injured in the least, nor will its edible qualities be harmed. *One point should be always borne in mind in using bisulphide of carbon, and that is its extreme inflammability; its vapour when confined is even explosive. No light or fire should be brought in its vicinity.*"—(L. O. H.)

I have used italics in the above sentence to draw attention as fully as possible to the very dangerous nature of the application unless used both with knowledge and care. I have myself seen ignition occur in the open air from the heat of the sun's rays. Also it should be remembered that the vapour of the bisulphide is prejudicial to the health, or even dangerous if inhaled in large quantity.

Another method of destroying infestation is to subject the attacked grain to a raised temperature.† It appears that it is not "so much the intensity of the heat as its continued action for a certain period which kills the caterpillars and chrysalids in the grain, so that from 45° to 50° during twenty-four or thirty-six hours produce more effect than 76° or 96° for one hour. Of course the heat must be regulated so as not to destroy germinating power, and it is stated to be considered that it is preserved at 190° Fahrenheit."

I have no personal knowledge on this point, and would advise investigation so as to make sure before trying the above plan. The heat may be applied in some form of heated oven or chamber, or in an ordinary room, or (formerly) by means of an iron cylinder, or other

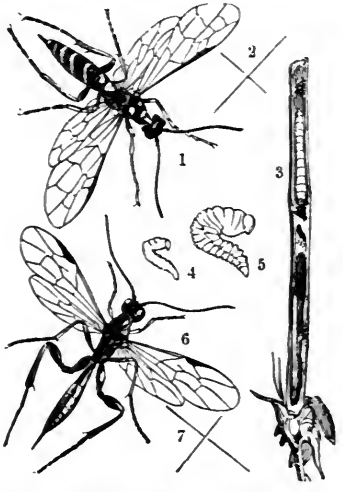
* And let the operator be careful not to shut up either himself or any living creature, excepting the insects to be destroyed.

† See 'Farm Insects,' by John Curtis, p. 313.

form of apparatus in which the grains could be exposed to a regulated amount of heat.* But at the present day, method of storage of the grain and fumigation appear to be the approved remedies.

There does not appear to be any reason for fear of the attack of "Angoumois Moth" establishing itself as a field pest in this country; but as we find that now we are open to its transmission on the broad scale of infested cargoes, we may have loss and difficulty in this respect, and in cases where the damage only affects the value of the Barley slightly for use for malting, probably the best course would be to sell the grain as soon as possible for immediate use.

Corn Sawfly. *Cephus pygmæus*, Curtis.



CEPHUS PYGMÆUS.—1, 2, Corn Sawfly, magnified, and line showing natural length; 3, infested stem; 4, 5, maggot, natural size and magnified; 6, 7, parasite fly, *Pachymerus calcitrator*, magnified, and line showing natural size.

The damage done by the Corn Sawfly is caused by the fly piercing the growing corn stem with her egg-laying apparatus, and laying an egg within, the maggot from which eats its way upwards, piercing through the successive knots. When nearly full grown it returns downwards, and about harvest time bites a ring round the inside of the stem at the ground level or thereabouts, but without damaging the outer part of the straw. Having done this, the grub goes yet further down into the lower part of the stem, and there it spins itself a cocoon, a silken case, in which it passes the winter.

Meanwhile there may be little in the appearance of the crop to draw attention to what is taking place, excepting that the ears look

* For full details see Curtis's 'Farm Insects,' pp. 313, 314.

thin, and not of the right colour, and also are without the proper amount of grains, or perhaps have none at all. But presently, that is, towards harvest time, if there should chance to be a high wind, or the attack is severe, the mischief will be thoroughly noticeable, consequently on the great quantity of straw broken off (as if "laid" by the wind) at the grub-bitten ring just above ground-level.

The attack sometimes is very injurious, and is widely distributed on the Continent, but is by no means one of frequent occurrence (at least to a noticeable extent) in this country. On looking over my Annual Reports from 1877, inclusive, up to date, I find that in 1878 it was slightly noticed, and in 1880 it was reported from two localities, one near Ashford, in Kent, the other near Maldon, in Essex, and it was remarkably numerous at both places; but, excepting in the above-mentioned instances, I have no reports of its presence up to 1885, inclusive. In 1886, the year of the appearance (as a crop pest in this country) of the Hessian Fly, we had observations also of some degree of presence of the Sawfly; and in 1887, the great year of Hessian Fly, we had also the largest amount of Corn Sawfly attack of which observations have been sent. In 1888 there was some amount, but in the succeeding years there has been either no report, or none worth record, until in the past season some slight mention has again been sent in.

In the case of an attack of this kind, which has a capacity of doing great mischief, and also (consequently on the habit of the insect of wintering in the very lowest part of the stubble) can be greatly kept in check by common agricultural measures, it may be of use to note, as above, the date of its appearances, and to give some additional details of habits of the insect, and means of preventing its ravages.

On August 2nd some very characteristic specimens of the attack in Wheat stems were sent me by Mr. D. D. Gibb, of Ossemsley Manor Farm, Lymington, Hants. The stems were pierced through the knots, and the joints more or less filled with the "frass" or dirt from the insect-workings, and in one stem I found that the larva (grub) had spun its case for wintering in, down near the ground-level.

The grubs of this *Cephus pygmæus* (like the others of the family of the *Cephidæ*, to which it belongs) are footless, excepting three pairs of very small tubercle-like feet on the fore part of the body. At the extremity of the tail is a projecting point, which can be drawn in or extended like a telescope, and this helps the maggot in its progress along the inside of the straw. The head is rusty-coloured, horny, and with strong jaws. The general colour is white or yellowish white, the texture fleshy, the length about half an inch, and the shape as figured at 4 and 5, p. 21, thickened in the part next the head. The maggot feeds on the soft inner portions of the straw, and after having travelled wholly or partly up the stem and come down again, and spun itself up

in a cocoon within the lowest part of the stem, as mentioned at p. 21, it spends the winter (still in larval state) in this shelter. In the early summer it changes to the chrysalis state, from which the Sawfly comes out in time to lay her eggs on the corn; it is considered that one egg only is laid in each stem, the female fly continuing to lay on successive stems until her supply of eggs is deposited. Wheat and Rye are both subject to attack, and Barley occasionally suffers.

One of my correspondents who was well acquainted with the appearance of the attack reported it in 1887 as present in Barley stems in the neighbourhood of Goring Heath, near Reading, but he observed that Oats were not infested, even when growing in the same field mixed with the Barley.

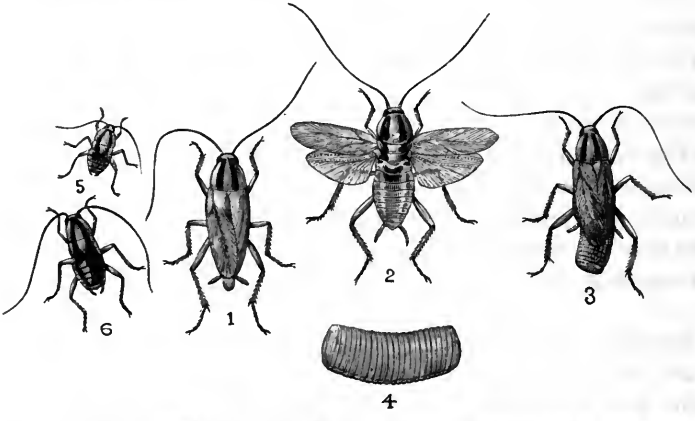
The fly is of the shape figured at 1, p. 21, and about a third of an inch in length. The general colour black, varied more especially in the male with yellow. The antennæ black and yellow. The flies are to be found in summer on grass in woods, and on flowers in corn-fields, and especially on those of umbelliferous plants.

Prevention and Remedies.—The maggot winters in its spun case in the lowest part of the corn-stem, at or below the ground-level, where it is left undisturbed by the falling of the upper part of the stem which it had cut through, and any method of destroying the stubble, in which it is thus harbouring, is an effectual method of clearing the infestation.

This may be done by whichever of the common agricultural methods is preferred. All that is needed is to skim or loosen the surface, so that the lumps of stubble may be collected and gathered in heaps and burned. Common ploughing in is not to be trusted, for a great deal of the stubble would not be buried away deeply enough to prevent the fly coming up through the ground at hatching time. Some part of the infestation would be got rid of, but not all. Where burning the standing stubble can be conveniently managed, this is an excellent plan for killing the grubs, but this is so rarely done that there is risk of causing more harm than the good would counterbalance. Where, in case of bad attack, it is wished to try this plan, it may be safely managed in the Canadian method by firing the field first round the borders. Thus, instead of the fire going wildly where the wind may drive it, there is only a slight heat at first and a line of fire under control near the hedges. The fire thus spreads over the dry stubble towards the middle of the field, and the flames cannot return over the already charred surface.

COCKROACHES.

German Cockroach; "Croton Bug" (U.S.A.); "Steam Flies." *Phyllodromia germanica*, Linn. **American Cockroach.** *Periplaneta americana*, Linn.



PHYLLODROMIA GERMANICA.—1–3, adult insects; 2, with wings expanded; 3, female with egg-sac attached; 4, egg-sac;—all magnified; 5 and 6, young, still wingless forms. After figures by Prof. Riley, and specimens.

For some years back enquiries have been sent me from time to time regarding the best methods of getting rid of the exceedingly inconvenient presence of the small yellowish brown, striped Cockroach, generally known as the "German Cockroach," but frequently, in the United States, as the "Croton Bug."

In one instance, the infestation was complained of as causing great annoyance on one of the lines of steamships from the north of Ireland to the United States of America; in another (reported in 1896), a good deal of detail was given of amount of presence, and of means which proved only partially successful in getting rid of the pest in a large hotel in one of our chief manufacturing towns in the north of England, where it was mentioned that "We are, like most other hotels, much troubled with what are called 'Steam Flies.'"

It appears now, however, that this small kind of Cockroach is very widely distributed in this country, and by reason of its greater rapidity of multiplication than our long established kind (popularly, though very incorrectly, known as "Black Beetles"), and also its greater destructiveness, it would be such a serious inconvenience for this species to be generally established with us, that it may be of use to refer to it again this year.

These "Croton Bugs," or German Cockroaches, are only about half an inch or very little more in length at their fullest size, and are marked as shown in the figures at p. 24. The colour is variable, but may be described generally as of a light or yellowish brown, with two dark stripes running along the upper surface of the fore part of the body. By these distinctions of size and colouring, this *P. germanica* may be known from our common larger and dark pitchy-coloured Cockroach, vulgarly known as a "Black Beetle," scientifically as *Blatta* (*Periplaneta*) *orientalis*, and there is the further distinction that while both males and females of the German Cockroach possess two pairs of wings, our own long established "Black Beetle" is only winged in the male sex. The female is wingless, excepting some amount of rudimentary development chiefly, if not entirely, of the upper pair.

In regard to various localities where the *P. germanica* has been seen, Mr. G. H. Carpenter, F.E.S., writing to me from the Museum of Science and Art, Kildare Street, Dublin, on May 21st, observed:—"We have had outbreaks of the German Cockroach in the Zoological Garden here, and at one or two private houses."

I had also a somewhat interesting observation from a relative, resident in St. Bartholomew's Hospital, London, of an establishment of the "Common Cockroach" in one part of a block of the buildings, and of the German Cockroach in another part of the same building, each kind living quite apart from the other. It was a matter of some speculation which kind would drive the other out, but at the last information which I received, the German Cockroaches had disappeared. What had become of them was unknown; but some observations on "The Migration of Cockroaches," by Dr. L. O. Howard (Entomologist of the U.S.A. Board of Agriculture), suggest that they may have possibly removed themselves elsewhere; but whether this was so or not, Dr. Howard's note throws an important light on the reasons of occasionally unaccountable intrusion of this visitation.

In the instance recorded, vast numbers of these "Croton Bugs" were watched by Dr. Howard, Mr. P. H. Dorsett (one of the Department of Agriculture staff), and many others, making their way from the back of an old restaurant near the Department grounds at Washington, and trying to effect a lodgment at the opposite house. From this they were kept out with much difficulty, and only by strewing hot ashes along the side walk; the migrants when they could not go forward dividing right and left, and going down the neighbouring areas. On enquiry at the restaurant, it was found no measures had been taken to drive them away, and it was supposed that, as most of the Cockroaches were females carrying their egg-cases still undeposited (see figures 3 and 4, p. 24), they were under the

influence of some instinct prompting them to search for new quarters. The day was particularly dark and drizzly, and, to quote Dr. Howard's words, "The darkness of the day is significant, and there is no reason to suppose that similar migrations do not frequently occur, but undoubtedly, under ordinary circumstances, at night. This is the way that new houses become infested."—(L. O. H.)*

Returning now to observations of English localities of the German Cockroach, Mr. Malcolm Burr, F.E.S., writing to me from Dormans Park, East Grinstead, favoured me with the following notes:—

"German Cockroach.—I have found this species in several of the London restaurants when dining, and have received them from others. Also it is very numerous at Bradford, and I have found it in hotels at Folkestone." [Hastings and Aldershot were also mentioned by Mr. Burr as localities where he had reason to believe them to be present, but had not himself seen them.] "Brunner von Wattenwyl ('Prodromus der Europaischen Orthopteren,' p. 47) says† :—'In Wien kam sie vor 20 Jahren nur vereinzelt vor und ist jetzt allgemein verbreitet, indem sie die *Periplaneta orientalis*, L. verdrängt.' It is a perfectly cosmopolitan species. Although *germanica* has driven out *orientalis* at Vienna, I am informed by Mr. J. W. Carter that at Bradford both these species are very numerous, while *Periplaneta americana*, L., which used to be abundant, has disappeared. At the Zoological Gardens in London, *Periplaneta americana*, L., and *Phyllodromia germanica*, L., are both exceedingly numerous in some of the houses; the keeper's give the large *americana* to some of the animals to eat, *vide* E. M. M. vii. (New Series), p. 278."—(M. B.)

The *Periplaneta americana*, the American Cockroach or Black Beetle, is yet another kind which may need looking after here more than is commonly supposed. This is from an inch and a quarter to an inch and three-quarters in length, the fore body yellowish, with brown mottlings, and the horns exceptionally long, "reaching considerably beyond the tips of the closed wings, which themselves are long and powerful, and when closed reach beyond the tip of the abdomen."

A good detailed description will be found in the work mentioned below,‡ in which also the wing-cases of the male are said to be much longer than the abdomen, the legs and under side pale, also the upper side of the abdomen at the part nearest the fore body. The

* 'Insect Life' (United States Department of Agriculture), vol. vii. No. 4, p. 349. Washington, 1895.

† "In Vienna previously to twenty years ago they appeared solitarily, now they are everywhere distributed, and consequently have dispossessed the *Periplaneta orientalis*, L."—(Trans. E. A. O.)

‡ 'The Blattariæ of Australia and Polynesia,' by J. G. O. Tepper, F.L.S., &c.

greater size of this species distinguishes it readily from both of the previously mentioned kinds and "*our own*" Black Beetle, so to call it; and the distinctions of the *Blatta orientalis* being pitchy-coloured *without* markings; the small German Cockroach, *P. germanica*, being yellowish, with two dark *stripes;* and the American Cockroach, *P. americana*, being much larger than either, and with the yellowish fore body with brown *mottlings*, or two large somewhat rusty *spots*, appear to be sufficiently clear for general purposes.

The American Cockroach is stated to be found on "all continents," and for those who wish to follow up its destructive habits, the observations in 'Insect Life,' before quoted from, which can easily be run up by reference to the excellent recently published 'Index,' will give usefully interesting information.

I have not as yet had specimens sent me, but from enquiries made from time to time, I conjecture that this American Cockroach is present in London, besides its establishment at the Zoological Gardens, and that therefore it may be worth while just to draw attention to it.

Prevention and Remedies.—The remedy most approved of by the late Prof. C. V. Riley was fresh and "reliable" Pyrethrum or Persian insect powder. This to be applied by "puffing" it with a little hand machine into all crevices, drawers, cracks of old furniture, behind skirtings, everywhere, in fact, where the insects hide, and next morning clearing away all the dead or stupified Cockroaches that are lying about, and destroying them.

Various other insect powders, as Keating's, for instance, do good, if thoroughly applied; but the great point, which is very apt to be neglected, is the after treatment. Many of the Cockroaches will be only stupified, and if merely thrown aside to a dust-heap, will revive, and be perfectly able to fly or walk back, as the case may be, and re-establish themselves in their old home or in the neighbourhood.

Traps sometimes answer well, and a very simple and convenient plan is to set a small bowl on the floor, with some beer, or beer and sugar, at the bottom, and a few little pieces of stick arranged round, resting on the bowl at their upper ends, so as to form roads for the Cockroaches from the floor. The insects fall or crawl down into the beer, and are drowned or stupified, and if care is taken to throw the bodies into the fire, this simple method sometimes gets rid of a good many.

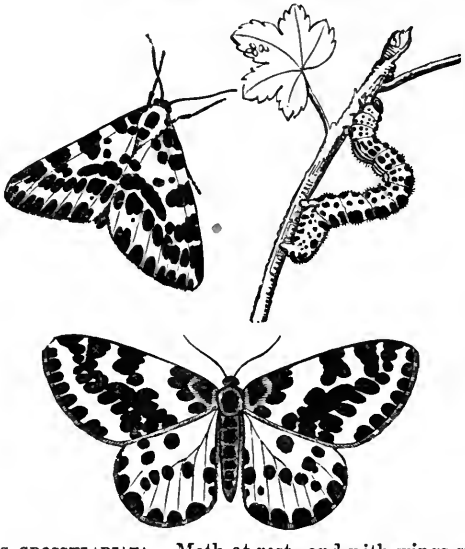
Filling up all chinks and crannies where the Cockroaches may harbour, or through which they may pass to and fro, is a very important item in treatment. If something distasteful is mixed with the plaster of Paris or rougher plaster used, it is a great safeguard against the insects gnawing their way through. Carbolic acid mixed with

lime-wash has been found useful for an application to walls, and probably carbolic acid might be very serviceably applied to prevent the Cockroaches making lodgments, or travelling through chinks, &c., into which the acid could be poured.

Sulphur fumigation is of great use where the attack is on such a large scale as to make the great trouble which is necessary to carry out this plan serviceably worth while; but of these various methods of dealing with the pests I have given details in my 'Twentieth Annual Report,' therefore do not offer them again. But *the* thing of all others that needs attention in order to clear out Cockroaches effectually, is that after they have been stupified or *apparently* killed, the fact should be *made sure of*.

CURRANT.

Currant and **Gooseberry Moth**; **Magpie Moth.** *Abraxas grossulariata*, Stephens.



ABRAXAS GROSSULARIATA.—Moth at rest, and with wings spread; caterpillar walking.

This pretty butterfly-like moth, known from the peculiarity of the markings on the wings as the Magpie, and also as the Harlequin Moth, is one of our most widely distributed garden leafage infestations, as it is to be found from the Orkney Islands at the north of Scotland to Kent and Devonshire in the south of England.

Amongst notes of Scottish localities, observations have been sent me from time to time of the caterpillars being found on Red and White Currant and also on Gooseberry leafage at Kirkwall Gardens, in Orkney; also at Dunrobin Castle, in Sutherlandshire, in the north of Scotland. On Black Currants at Portallock, in Argyllshire. On Black, Red, and White Currant and also on Gooseberry leafage at Colinsburgh, Fife. On Gooseberry and Currant also at Dalkeith Gardens, near Edinburgh, and at Oxenford Castle, in Midlothian.

In England it has been reported from Scotswood-on-Tyne, Northumberland, and from other localities too numerous to name, showing the distribution of the insect over a large part of England. But, though occurring in Cheshire and Herefordshire, observations of injuries from the attack have not been sent from the Welsh counties; nor have I had observations sent from more than one locality of its presence in Ireland.

The common garden food-plants of the caterpillars are, as mentioned above, Red and White, and sometimes Black Currants, and Gooseberry, and the leafage of Apricot and Plum is also sometimes attacked. The leafage of the Blackthorn or "Sloe" (*Prunus spinosa*, L.) is also a favourite food.

In the past season the prevalence of this moth was so very observable that it was noticed as follows in the article on "Agriculture" in the 'Times' of Monday, July 26th, 1897 :—

"Last week witnessed the sudden appearance of large numbers of the prettily-marked and readily recognizable Magpie Moth, *Abraxas grossulariata*, the invasion serving to call to mind the similar one of twelve years ago. This moth breeds a looper caterpillar, the colour markings of which are identical with those of its parent; it is a destructive pest of Gooseberry, Currant, and other fruit trees."

To the above Dr. W. Fream, writing from Downton, near Salisbury, on October 30th, in reply to my enquiries, kindly added regarding this attack:—

"It was exceedingly abundant locally, say South Wilts and South Hants, and I also had information from other districts."—(W. F.)

Early in the season I noticed some presence of the moths in my own garden at St. Albans, where I had not previously observed this infestation; and on April 21st the following note of the presence of the attack to a very injurious amount for several years back was sent me by Mr. T. W. Backhouse, of West Hendon House, Sunderland.

Mr. Backhouse observed that he wrote because he did not find I had mentioned in my Annual Report for 1896 "the pest of 'Currant Moths,' alias common 'Magpie Moths,' which has prevailed for some years—I think, four or five—in our neighbourhood. All attempts to overcome them have been more or less unsuccessful, excepting the

extreme measure which has been adopted in some gardens of destroying every Gooseberry and Currant bush that was not already destroyed by the caterpillars, and beginning with a fresh stock. We have not adopted that extreme course ourselves, but are told we shall be obliged to. The caterpillars were certainly worse last year than ever."—(T. W. B.)

This infestation has certainly a power of doing a great deal of mischief, but yet it may quite be hoped that preventive measures, based on knowledge of the habits of the insect, would be successful in clearing out the attack.

The duration of the whole life of the insect,—that is, the time included in the egg condition in summer, subsequent caterpillar state in autumn, winter, and following spring, and chrysalis, from which the moth comes out towards midsummer,—is about a year.

The eggs are laid, one or more as the case may be, on the leaves of the attacked plants, "not only in the evening, but even in the middle of a warm summer's day."* These soon hatch, and the caterpillars may be found in August and September, and feed for a while, but, it is stated, rarely longer than for four weeks. Before winter, they prepare a shelter by spinning the sides of leaves together, in which they may rest, and also spinning the leaf fast to the twig, so that when it fades, the caterpillar still hangs securely in the hung-up leaf, but in some cases the caterpillars merely drop down and shelter themselves in the fallen leaves below the bushes. In these situations they pass the winter, but with the appearance of the leaves in the following spring they come out again, and feed on leafage until some time during May, or towards the beginning of June. Then they spin their light transparent cocoons attached to twigs, or palings, or in crevices of walls, or possibly on the ground, from which the moth comes out towards the middle of summer.

The chrysalis is at first yellow, but soon changes to black, with yellow bands.

The caterpillar is commonly of a creamy or yellowish colour, with a reddish line along each side below the spiracles or breathing-pores, and has a large number of variously sized black spots on the upper part, a black head, and the three pairs of claw-legs are also black. The colouring, however, sometimes varies in amount of black marking, even to being entirely black, without any mixture of yellow or other colour.†

These caterpillars are what are called "loopers" (see figure, p. 28). They have only one pair of sucker-feet besides the three pairs of

* Newman's 'British Moths,' p. 99.

† See 'Larvæ of British Butterflies and Moths' (Ray Society), vol. vii. pt. i. p. 151.

claw-feet beneath the body, consequently, as they have to move these sucker-feet close up to the others in order to steady themselves in progression, they form an upright "loop" in walking, and by this habit, and by their yellowish colouring, blotched with black, they are easily distinguishable from the almost more destructive caterpillars of the Currant and Gooseberry Sawfly, often occurring in company with them. These have a dull pale or bluish green ground colour, with first and second segments partly orange, and those near the tail also orange, and the body sprinkled with black tubercles, each bearing one or more hairs, until the last moult, when the black tubercles are cast off. The above differences in colour, and the circumstance of the larva having six pairs of sucker-feet beneath the body, instead of only one pair (as with the larva of the Magpie Moth), are very easy methods for distinguishing these two infestations.

The Magpie Moth is variable in colouring, but when regular in its marking is easily known. Commonly it has a black head, yellow body between the wings, with a large black spot in the middle; the abdomen also yellow, with five rows of black spots. The wings are white, spotted with black, and the fore wings have a yellow blotch at the base and a yellow band across them. There are, however, almost endless varieties of markings, from black of different shades to white; some have the upper half of the wing white and the lower black, or the reverse; some have the ground colour of the wing (instead of merely a band) yellow; and in some cases the hinder wings are striped with black. It is noteworthy, however, that, as recorded by Mr. Robson, the black variety of larvæ observed by him near Newcastle-on-Tyne only produced the common form, not the especially black marked varieties of the moth. (See reference to black larvæ, p. 30.)

Prevention and Remedies.—The habit of the caterpillar of wintering in spun-together leaves still hanging on the bushes, or sometimes lying amongst any shelter on the ground beneath, is the special habit to be acted on to get rid of it thoroughly. At pruning time the bushes should be very carefully gone over, and also examined afterwards to be sure that there are no leaves which may hold a caterpillar in the spun-together fold left on the bushes. Also, where the bushes have several stems so placed that infested leaves or insect vermin might lodge, it is particularly desirable that such lurking-places should be cleared out, or some trustworthy insecticide poured in. Where Currant bushes are trained on walls, search is especially requisite. It should also be borne in mind that the longer the pruning can be deferred, the more sure it is, to be a good remedy. If the caterpillars have either not become thoroughly torpid, or the weather is sufficiently open for them to re-establish themselves, many will escape by creeping away,

and sheltering again at the surface of the ground. This precaution applies also to date of dressing away possibly infested rubbish from beneath the bushes, which, as well as pruning, is a very desirable preventive. All the prunings and clearings from beneath the bushes should be collected and burnt, in order to avoid any chance of the caterpillars, which would otherwise survive in them till spring, then coming out and crawling back to the bushes.

I have had notes from localities where caterpillar attack was *customarily* bad, and as far as I could judge, it was the *non*-complete removal of the infestation consequently on the early autumn pruning and dressing of the ground beneath the bushes which was the reason. But if the bushes and the ground beneath are properly cleared, respectively by pruning and removal of hanging leaves, and by removal of *surface* shelter below, the pests are *so absolutely cleared out* that there is nothing left to continue attack in the spring.

Removal of the transparent cocoons from any places, as palings, walls, crevices, or boughs, towards the end of May or beginning of June would of course be very desirable, for thus we should get rid of the coming brood of moths; but when the leafage on bushes and walls is in full early summer luxuriance, it is not likely the cocoons will be noticeable unless the infestation is to a quite unusual amount.

Amongst mechanical remedies, hand-picking, if the attack is taken in time, and a good number of workers put on so as to carry through the clearance at once where the Currant or Gooseberry growing is on a large scale, has been found to answer well. Also (as a preventive), where this conspicuous moth is seen in large numbers, it would be worth while, and quite possible from its day flying and quiet habits, to lessen its numbers greatly by use of a common butterfly-net, or sometimes even with the hand.

Placing pieces of canvas or sheets below the bushes, and shaking or jarring the boughs sharply so as to dislodge the caterpillars, and then gathering them up in the cloths and destroying them, has been found good treatment.

For dustings or sprayings, powdered hellebore is one kind of effective application so far as killing the caterpillars is concerned; but it is so very poisonous, and the effect would be so dangerous to all who partook of the fruit, unless it had been washed quite free from the dressing, that I cannot take upon myself to advise it.

Flour of sulphur dusted on the leaves *when the dew is on* so that the powder would adhere, or a liberal application of soot similarly used, are serviceable remedies and quite safe.

Paris-green sprayings, though these to succeed properly should be in such minute quantity of the arsenite contained that they would be (demonstrably) perfectly without any cause of risk to the consumers of

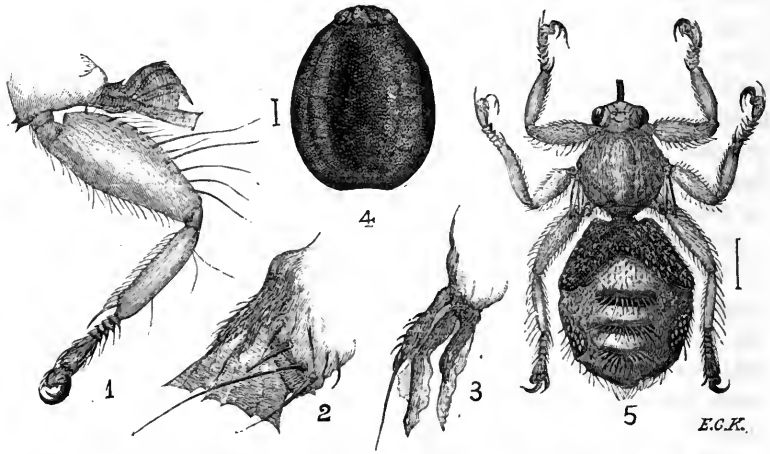
the fruit, yet might raise a prejudice against it injurious to the seller; but the well-known "kerosine emulsion" would do much good without danger, and the "anti-pest" of Messrs. Morris, Little & Son, of Doncaster, which is almost the same as the kerosine emulsion of the United States of America in constituents, but is sold ready mixed in a semi-fluid state at a very cheap rate, would probably save much trouble and damage, from (respectively) the difficulty there usually is in mixing the "emulsion" so that the kerosine and soft-soap wash may unite permanently in the operation of mixing, and the great harm to the leafage in case the mineral oil separates, so that the kerosine (or paraffin) remains undiluted on one part of the leaves, and the soft-soap remains, not doing all the good that it was meant to do, on the other.

The following observation, with which I was favoured by Mr. S. L. Mosley, F.E.S., of the Beaumont Park Museum, Huddersfield, is of practical interest as to one branch of ornithological *non*-assistance in the matter! After mentioning that he had seen this infestation commonly in Cambridgeshire, Lincolnshire, Notts, and parts of Yorkshire, and also had notes of its extreme abundance near Bradford, Ilkley, Pickering, &c., Mr. Mosley added:—

"In some places where Magpie grubs have been abundant, I know that sparrows are plentiful, so it is clear they do not take them—at least, if they do, not to any great extent."—(S. L. M.)

DEER.

Deer Forest Fly. *Lipoptena cervi*, Nitzsch; *Lipoptera cervi*, Von Siebold and Loew.

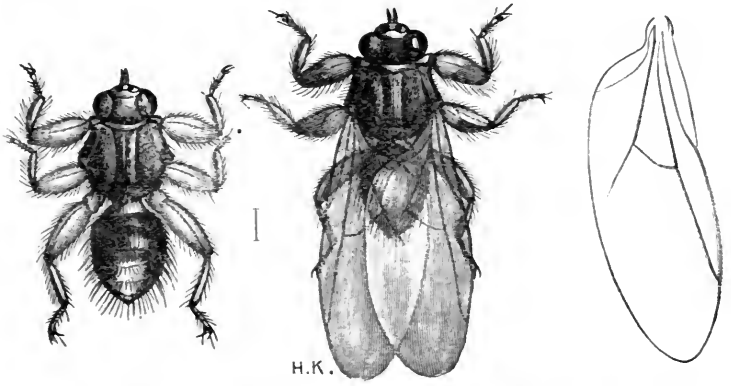


LIPOPTERA CERVI, female.—1, leg and base of wing; 2, base of wing; 3, abortive wing; 5, female fly, with base of wings—all much magnified; 4, puparium, much magnified, and line showing natural length.

The Deer Forest Fly is a much lesser evil than the allied kind, the *Hippobosca equina*, the Forest Fly of the New Forest, as it does not (like this kind) infest cattle and horses, the latter especially, to their intense terror until they become accustomed to the visitation, and also to the great risk under these circumstances of their riders and drivers. Still the *Lipoptera cervi*, or "Deer Bugs," as they are sometimes called, are to be found in numbers of hundreds, or in clusters, on the Red and the Roe Deer, and though their blood-sucking powers do not appear to be to an important extent, they cause great annoyance by the speed with which they can run in any direction amongst the hair, and the tenacity with which they can attach themselves; also those in winged condition cause much annoyance to people walking through woods or localities infested with them in the later part of the summer.

During 1896 I was enabled, through the kind assistance of Mr. Dugald Campbell, of Strathconan Forest, Muir of Ord, Ross-shire, N.B., to give some information regarding the habits of these flies from notes which he favoured me with from his personal observations, and also from specimens sent accompanying, and which, with the addition of various important points in the history of the infestation taken from the published accounts of the chief German writers on the subject, make it unnecessary to go over these details again here.

But in the past season I had hoped to add something on the amount of wings possessed by the female fly,—an interesting subject which has long attracted attention with regard to whether she developed from the pupa-case without them, or shed them, or whether there were modifications of structure or partial removal.



LIPOPTERA CERVI, male, with the wings thrown off; also still retaining wings; line showing natural length; and wing, also much magnified.

In the case of the male of this *L. cervi*, it is developed with wings (see figure above) remarkable for their length compared to that of the body of the fly, but it has the power of dropping the wings,—shedding them off or getting rid of them entirely in some way when the fly settles on a Deer, or what it considers (so to say) may serve for a "host" animal. In my own observations of specimens sent me, I have found so many instances in which the absence of a great part of the wing was caused evidently by the piece having been torn away, leaving perhaps as much as an eighth or more attached to the body, that it appeared to me that this partial removal had very likely been done by means of their flat curved claws, which, if the sides with transverse furrows were pressed together, would be admirably suited to the work.

The history of this *L. cervi* given shortly is that it is one of the division of the *Pupipara*, that is, it multiplies not by depositing an egg, or anything like a maggot or larva with the power of moving or feeding, but a kind of chrysalis-case or *puparium*, in which the forming insect comes to maturity, and emerges as a perfect fly.

In regard to the special kind under consideration, it is found on the Red and Roe Deer, and on the Continent of Europe also on the Elk, whence one of its synonyms, that of *Alcephagus pallidus* of Gimmerthal. Some of the other names under which this species has been distinguished by various entomologists according to the especial peculiarity which he observed, or the animal on which he studied it,

are *Pediculus cervi*, Linnæus (1761), *Ornithobia pallida* and *Melophagus cervi*, Meigen, and *Hæmobora pallipes*, Curtis.

The fly may be generally described as flat, and of a horny texture, with the two wings, when present, laid flat on the back, overlapping at the edges, and projecting very much beyond the end of the tail (see figure, p. 35), and it is about a sixth of an inch in length from head to tail, consequently smaller than our common Forest Fly (*H. equina*), which is about a quarter of an inch in length.

The general colouring is of a horny brown or yellow; the head yellowish, with the top of the head and the mouth parts brown. Thorax flat, chiefly brown, with small bristly warts. Abdomen yellowish or brown, or brown and grey above in the female, covered with minute warts bearing bristles, and variable in shape,—small in the males, somewhat cylindrical or inclining to be conical; larger at the extremity in the females. Legs chiefly yellow; thighs short and thick; legs hairy; claws black, long, curved, and horny, each with a somewhat thumb-shaped much shorter claw at its base, and the curved claws having transverse furrows on the sides, and saw edges, as in the case of *H. equina*.*

In my 'Twentieth Annual Report' I have given detailed descriptions of the habits and appearance and other points so far as seemed serviceable for practical use in regard to this *L. cervi*, with such full references to the works of special writers on the infestation, as Professors Von Siebold, Nitzsch, Loew, &c., that, as this paper is only meant as a record of such amount of information as I have been able to gain in the past season regarding wings of the female as observable on British specimens, I have not repeated the matter or references; but for those who wish to go into the history of this *L. cervi*, as given by different observers under different synonyms, the list of publications given in Dr. Rudolph Schiner's 'Fauna Austriaca (Die Fliegen),' ii. Theil, p. 649, will be found useful.

The following notes refer to the North British observations and specimens sent me in the past year.

On February 9th, Mr. Campbell, writing from Strathconan, sent me the following observation of the great amount of the infestation which he had observed present in the case of a Roe Deer in noticeably bad health. After some general remarks, Mr. Campbell remarked:—

"To-day, however, I have happened to fall in with a Roe Deer which looked the picture of misery, and which I shot out of pity. I

* For figures of the foot of *Hippobosca equina*, with bristle-like central appendage, &c., much magnified, see my 'Nineteenth Annual Report,' p. 99; and for full details see the two accompanying plates, in which the foot and its apparatus is given as seen from above and sideways, magnified to a size of about seven by three to four inches.

found this poor brute to have rubbed the hair off both its sides as bare as to show the bare skin. No doubt this happened in its endeavour to get rid of those pests the 'Forest Fly,' which I found in clusters in the thickest part of what remained of the hair; they evidently collected there (about the chest) having no shelter on the other parts of the poor brute's body in this cold weather, being almost quite hairless. Thus it can be seen how those brutes suffer, not only from the ravages of these pests, but as well from exposure."

With a piece of the Roe Deer skin, sent accompanying, was also a consignment of the Forest Flies.

With regard to annoyance and some amount of injury caused by the Forest Fly to Deer, Mr. Campbell wrote me on March 27th as follows :—

"There are some of the opinion that the 'Forest Fly' does not annoy the Deer when once they get used to them. I cannot believe but they are a source of great annoyance to them. I often see stags and hinds with the hair on neck and sides about this time of the year nearly all broken, so much so, that the skin is nearly exposed in some cases. They are seldom found on Deer that habitually keep the open ground; only those that live in the woods I have noticed as afflicted with them."—(D. C.)

About a week later, on April 2nd, Mr. Campbell sent me a Roebuck's skin, also from Strathconan Forest, Ross-shire, for purposes of examination. This proved to be of a beautiful deep fur, healthy, and very clean from any infestation, excepting a few of the Deer Forest Flies, so few that by careful examination, even by combing and shaking, I only secured about twelve of the *L. cervi*,—some alive, some dead; nor on this skin did I find any puparia loose amongst the hair.

All these Forest Flies, which I examined, appeared to be females. The colour of the head, thorax above and below, and of the legs was of various shades of pitchy. The abdomen pale grey below, commonly only "scalloped" or marked with patches of brown along the outer edges and at the base with a cross-band of the same near the apex; in one specimen these side bands were absent. On the upper side the abdomen had a grey ground colour, marked across at the base with pitchy, this pitchy colour extending about a third along each side, and altogether forming a kind of broad made V-shaped marking, with the points directed backwards (see figure 5, p. 34). Along the upper side of the abdomen were three narrow brown cross-bands,—the band or patch above the caudal extremity being darker in colour and wider than the other two.

In the course of examination I noticed that the abdomen of one specimen was black in colour and distended, and was hard to the touch, and on opening this very carefully, I found within a black

puparium, completely filling the abdominal cavity, so that the external coating was a mere skin. This I carefully rolled back, and gradually detached, injuring it as little as possible, until by pressure I was able to completely disengage the puparium, and on comparing the markings of the specimen, thus clearly proved to be a female, with most of those sent me together with it on April 2nd on the Roebuck's skin, there was no difference to be found.

On examining this specimen from which I had removed the puparium under a one-inch object-glass, I found that it possessed abortive wings, or remains of the lowest portions of the wings from which all but a small quantity of the base (so small as to be almost invisible to the naked eye) had by some means been removed. Another of the specimens also appeared, from the dark colour and distended state of the abdomen, to contain a puparium. These specimens and others of the same consignment which I examined had abortive wings or remains of wings, as above described. In all cases where I was able to get a good view there was membrane with longitudinal veinings.

As I was desirous to be perfectly certain that the specimens (independently of course of the one in which I found the puparium) were females of the *L. cervi*, I ventured to send samples to Prof. Jos. Mik, of Vienna, who was good enough to give me in reply much valuable information, from which I extract the following points:—

"All the specimens you send me are quite certainly females, and fully developed ripe females."

With regard to the black puparium which I forwarded, Prof. Mik observed:—

"The puparium is interesting to me because I possess one which is reddish white, not chitinous (like a larva), but has at the hinder pole a chitinous black shining plate. My puparium is doubtless immature, and has probably been taken by the huntsman from whom I received it with specimens of the imagos out of the abdomen of a female. I have also opened a female which you sent me, and found a light-coloured puparium with black plate in the abdomen. The black spot lies at that end which is directed towards the posterior portion in the abdomen of the imago. It has to be examined if it is after all the anal pole of the puparium" (J. M.); and here Prof. Mik suggested where to search for technical information.

On re-reading the above on November 4th, it occurred to me that possibly the contents of the only puparium now remaining to me of the specimens sent me by Mr. Campbell early in the year might have developed sufficiently to show the position of the imago. Two specimens had been sent me (either on February 9th or April 2nd—I think at the earlier date) which were then of a full black colour, hard, and

very glossy; of these I unfortunately lost one, but from the other the figure given at 5, p. 34, is taken. The general form was, as will be observed, elongate heart-shaped, or oval, slightly concave at the larger end, and the other bluntly produced, so as to resemble a cap or plate with a few raised markings running from the edge to the centre. The central portion of the side figured was noticeably elevated for most of the length, and on each side of this central swelling, between it and the edges of the puparium, was a row of little pits or depressions (see figure). The other side was flatter, and the little pits not so noticeable.

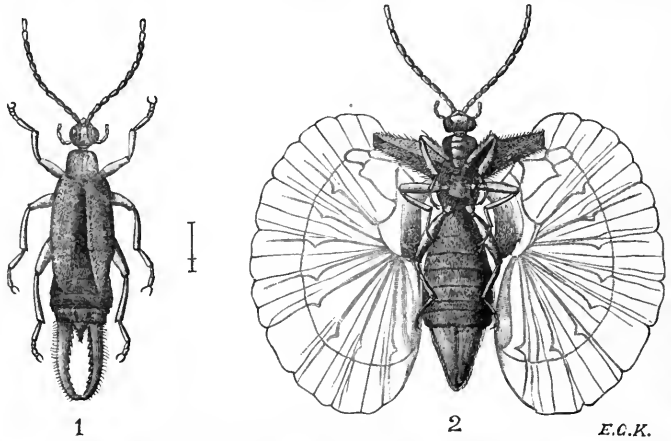
On gently pressing the puparium (on November 4th) it cracked open, and I found the insect within, lying with its head towards the concave end, its tail towards the convex somewhat produced extremity. The eyes were very large, and the wings, which were not as yet inflated, but lying as mere strips one on each side of the fly, reached to about two-thirds the length of the abdomen. The abdomen was shrunk, but from the pointed form of the extremity, as examined under both a two-inch and one-inch focus-glass, it did not seem to me to be open to doubt, although not as yet fully developed, that it was a male.

The above observations, which I merely submit as being such notes of the amount of wing development of the female of *L. cervi* in this country as I have been able to procure to accompany my previous notes of the infestation in the same locality, appear to me to show that in every instance the female had some amount of wing presence. It might be quite abortive, and consisting merely of short distorted veins with a little wing membrane at their sides, or it might be just a short piece of what appeared to be the lowest part of a healthily-formed wing from which the rest had been torn away by some agency removing it by a more or less straight fracture across the wing. In no instance was the female totally without any representation of wing like the male fly when its wings are wholly gone, as figured at p. 35.

If we could procure a supply of puparia and develop the perfect insect, we should of course gain much information on this interesting point. But failing this, it seems to me that if we could but get puparia from the coat of the Deer, or possibly where the Deer had been lying, we might make a great advance by anatomizing them. As the time for the appearance of the fly out of its chrysalis or pupal case drew near (possibly towards the end of June or during July), we might by careful manipulation crack open the case so as to secure the contained imago, and, if fortunate enough to have female specimens, be able to note their condition exactly.

EARWIGS.

Lesser Earwig. *Forficula minor*, Linn.; *Labia minor*, Leach.



1 2 *E.C.K.*

Labia minor.—1, male; 2, female with wings expanded, much magnified; line showing natural length of body and forceps.

On April 20th I received, by favour of the editor of 'The Farming World,' specimens of a small kind of Earwig, together with the enquiry :—

"Can your entomologist tell me what sort of insect pest this is, . . . and what would exterminate them from the hot frames where young plants are being struck at present? They seem to come from the manure, are in immense numbers, and actually clear off entirely such young growths as they attack."

On examination, the insects proved to be specimens of the Lesser Earwig, *Forficula minor* of Linnæus, now placed in the genus *Labia* of Leach.

Fully detailed descriptions of the insect will be found in the works referred to below,* and the following notes of the chief characteristics of the insect I have mainly abridged from the description by Fischer.

This is the smallest of the European species; the length of the body only about the fifth of an inch or slightly more; of the nippers or tail-forceps of the male about the twelfth of an inch, of the female rather less. The general colour testaceous, and the insect downy. Head black; horns (antennæ) fuscous, 10–13-jointed, with the lowest joint and those at the extremity often quite pale. Upper part of the body next the head (pronotum) somewhat square, at the hinder part

* Fischer, 'Orthoptera Europæa,' p. 70, 1853; also 'Ortopteros de Espana y Portugal,' por Ignacio Bolivar, pp. 26, 27; Madrid, 1878.

rounded and minutely punctured, the side margins and hinder margins reflexed. The wing-cases (elytra) very finely punctured and truncate at the extremity, with the suture impressed towards the apex (see figure 1, p. 40). The projecting part of the folded wings more than half the length of the wing-cases, and when unfolded of the most beautiful transparent texture and great size (see figure 2, p. 40). The breast and feet pale. The abdomen reddish brown above, black at the sides, pale below; the terminal ventral segment in the male compressed at the hinder part in the middle into a sharp point, much prolonged between the forceps (see figure 1); the arms of the forceps or tail-nippers a little curved, finely serrated along all the inner margin, and the apex incurved. Of the female (see figure 2) the nippers are triangular straight, and bluntly pointed.

In my specimens I found some difference in the colour of the upper part of the abdomen, one of them being, as described above, red-brown with the margins black, and another, as described by Stephens,* with the abdomen reddish, black in the middle; but the smaller size of this species compared to the other European kinds is a very good guide to identification.

On May 10th Mr. Jas. T. Hutchison, to whom I had been indebted for the Scotch specimens, sent me a further supply, with the observation:—

"They have evidently emanated from the manure used for the hot-bed, and do not seem to have made any ravages upon the contents of a 'cold frame' in pretty close proximity to the hot one."

The special love of this "Lesser Earwig" for manure-heaps, as well as for moving in great numbers together, seems to have long been known as characteristic.

In 1841,† John Curtis wrote:—"There is a small species called *Labia minor*, which seems attached to muck-heaps, and sometimes flies in such immense swarms in the sunshine that I was once covered with them in an instant."

Stephens in his observations on this kind (see previous reference) mentions they are "very abundant in the spring throughout the metropolitan district, flying about in gardens and near stables, &c., especially in the vicinity of dung-heaps."

Also so long ago as 1826‡ an observation by Mr. Marsham (a well-known entomological writer) is quoted as follows:—Once a little before sunset, observing overhead a number of insects on the wing moving off in one direction, he caught some of them, and they proved

* 'Illustrations of British Entomology,' vol. vi. p. 8.

† See 'Gardeners' Chronicle' for 1841, p. 580.

‡ See Kirby and Spence's 'Introduction to Entomology,' vol. iv. p. 514 of the edition of 1826.

to be *Forficula minor*, L. Struck with the circumstance, he watched them several evenings, and on one of these, as he was looking about a melon-pit for insects, he saw these little creatures alight on the frame, hastily fold up their wings, and entering under the glasses, run down its sides and bury themselves in the loose earth. This he observed repeatedly in September.

As yet no notes have been sent, nor have I been able to find any record of this kind being generally injurious; but their capacity for coming in the swarms mentioned, and clearing off young plants in frames, would make it desirable for garden service to have further information of the habits of this kind, and also of means of prevention.

Earwigs (speaking of the habits of our various kinds together) multiply by laying a number of eggs in a cluster, which it is considered the mother insect watches over with great care, unless from some exceptional circumstance she varies the state of affairs by eating them. The young Earwigs hatch out of the eggs resembling their parents in shape, but without wings or wing-cases,—when the moult to the pupal state occurs, the wing-cases are to be found; and in the case of the Lesser Earwig when the moult to the complete state occurs, it may be known by its comparatively small size, and also by the great amount of projection of the folded wings from beneath the wing-cases. Still, our common kinds of Earwigs look so very much alike, unless examined with the help of a magnifier, that it is very likely this "Lesser Earwig" may often be looked on as the young of the "common" kind, and may be doing special mischief that might be prevented.

So far as observations go, attention to the surface of manure-heaps when of a material or in a condition for egg deposit would be desirable. A little gas-lime sprinkled very thinly over the surface, or gas-water, diluted with about four times the quantity of common water, would do good rather than harm to the manure, and be a great deterrent of egg-laying, also might kill any young and tender Earwigs hatching out within reach of the application.

The applications tried by Mr. Hutchison's gardener as deterrents in the frames, such as Keating's powder, carbolic powder, and even quick-lime, were reported to do no good; but possibly fumigating with tobacco might be beneficial. Also where the method of arrival of this small kind of Earwig has been recorded, it has not been by flying in, but by alighting on the frames, and folding up their wings, and then entering under the glasses. Under these circumstances it would seem as if something greasy or sticky might prevent the creatures making their way onwards. If cart-grease was smeared along the top edge of the outside of the frame and anywhere that it could be serviceably spread without annoyance to the gardeners in moving the lights, it

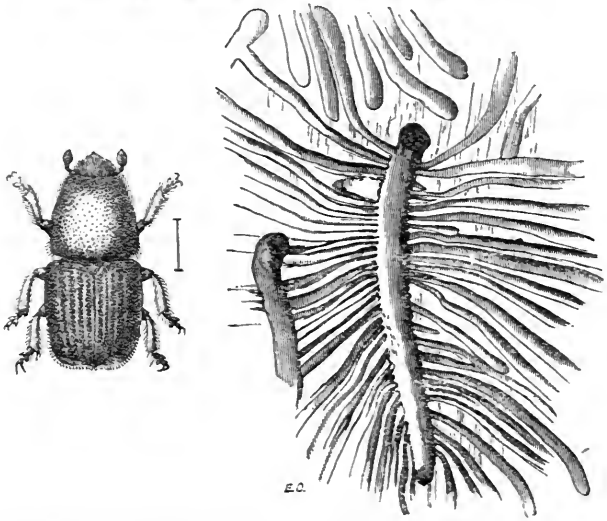
might do a deal of good. Or, if it is the constant habit of the Earwigs to run down the inside of the frames to reach the ground, a band of cart-grease run along inside, or a strip of tarred cloth run along, might catch great numbers, or at least check advance.

In one of his papers on Earwigs, Prof. Westwood mentioned that soaking a bandage in sweet oil was a good method of protection for any special purpose, and if a rough band moistened in some cheap coarse oil answered equally well, this could without difficulty be laid on the ground at the bottom of the inside of the frames.

The common methods of trapping Earwigs are too well known to need comment, but we do not know whether they would act with the somewhat different habits of this "lesser" kind, and a little further study of the infestation when specially seen at its destructive work in frames might give us a good deal of useful knowledge.

ELM.

Elm-bark Beetle. *Scolytus destructor*, Oliv.



SCOLYTUS DESTRUCTOR.—Beetle, much magnified (from 'Forest Protection,' by W. R. Fisher); workings in Elm bark, from life.

The Elm-bark Beetle is one of the very common and very injurious bark-infestations of this country. Quietly, and often without the presence of the mischief being observed (unless by good fortune attention

may chance to be attracted by the number of little perforations like shot-holes in the bark), the injury caused by the tunnellings of the beetles and the successive broods of maggots feeding between the wood and the bark goes on year by year till the passage of the sap can no longer take place, and the bark may be peeled from the wood in sheets of feet or yards in length.

This attack is very liable to spread, and besides its injuries in an economic point of view, it does great harm picturesquely by often attacking fine old Elms in public and private parks or avenues where they can be ill spared. Its history and habits have been thoroughly made out, but as they do not appear so well known generally as is desirable, some notes on the subject may be of service, and I first give just two of the observations which were placed in my hands in the past season, as describing the general appearance of the infested Elm trees. The following are a portion of the remarks with which I was favoured by Mr. John Martin, of Charley Hall, Loughborough, in which it will be seen that the separation of the bark from the tree is particularly noticed:—

"I found in my wood to-day six or eight Elm trees standing dead; on examining them I found the bark falling off, and in the bark a lot of small holes about this size, o. On peeling off some bark, I found between the bark and the tree some white grubs about the size of an ordinary maggot; they appeared to be boring into the tree itself. On some trees the bark had fallen off in long strips. I shall have the trees cut down, and removed as soon as possible. . . . I may say that though there are Oaks and Ashes close to the Elm trees that are damaged, I could not find any that had this grub in them. Also the part of the wood where these trees grow is a somewhat damp and wet part."

The description of the attack left little doubt that it was of the beetle especially known as the "Elm-bark Beetle," scientifically as the *Scolytus destructor;* but in order to be quite sure, Mr. Martin forwarded me, on April 3rd, a box of the injured bark, with specimens of the maggots accompanying, which made the matter quite clear; and on April 7th Mr. Martin wrote:—

"I am having the infested trees cut down to-day, and shall try my best to have the bark, &c., burned, and so to put an end to the pest."—(J. M.)

In the following observation sent me by Mr. Crisp, from the Estate Office, Elton Hall, Peterborough, it will be seen that the ultimate complete separation of the bark from the wood is also mentioned. An enquiry was sent for "the name of a small white grub that is doing much damage to a large Elm tree on this estate; it is nearly a quarter of an inch long, and is in the bark of the tree. The birds are stripping the tree of the bark, and the tree will die. Can anything be done?

A few other trees are slightly attacked. Is there any fear of it spreading?"

The little beetles which cause this serious injury are of the shape figured at p. 43, only about a quarter of an inch or less in length, and less than half that measure in breadth, of a black colour, with the wing-cases, which are square-cornered, reddish or sometimes black or pitchy, the shanks and feet reddish or lighter brown than the beetle, and the horns (antennæ) also reddish or lighter brown, short, slightly elbowed, with the lowest joint long, and the terminal joints forming a club.

The grubs are whitish, curved, fleshy, much wrinkled across, and legless, and have the three first segments swelled in shape, which serves to distinguish them from others of the many parasitic larvæ or other co-tenants of the infested bark.

The attack begins towards the end of May or beginning of June, and though it is considered to be mostly to trees which from some cause are not in full health, yet it may be to the stems of young as well as old, and healthy as well as sickly trees.

The females work their way along the bottom of cracks in the bark, widening them, it is stated, as they go along before beginning their tunnels for egg-laying. These tunnels may be from three to five inches long, and take about three weeks to form. The eggs are laid along each side, and may be above a hundred in number. As the grubs hatch from the eggs, they each start gnawing their tunnels at right angles from the parent gallery,—the size of the tunnel being enlarged to accommodate the increasing size of the larva; so that where there are many eggs laid closely side by side, there very soon ceases to be room for all the grubs, and the tunnels of the strongest and most rapid in working take all the space, and the weaker grubs perish. Many of the grubs are full-fed towards the end of July, and turn to the pupal or chrysalis state at the end of their burrows, and the beetles from these pierce through the bark, and come out from the tree in August, the little shot-hole-like perforations showing where they have escaped.

The greater number of the grubs, however, appear to pass the winter either just within the wood or in the thick bark, and to come out as beetles in May, ready to begin summer attack. It is considered that they prefer a tree which has already been attacked rather than one which is sound and vigorous, and in which consequently the full flow of sap might be prejudicial to the young grubs; and, so far as I have been able to watch the attack myself, I believe that the great proportion of it will be found to be to trees not in their full vigour.

The above remarks give a general description of this very injurious timber infestation, of which it may be remarked in passing that it has

been recorded as occasionally infesting Ash (*Fraxinus excelsior*) as well as Elm; but the attack has been entered on at such length by various writers, that I give at the end of this paper references to some of the published observations.

Prevention and Remedies.—The chief and most simple method in regard to prevention of attack is removal of all centres from which infestation might spread to sound trees; and amongst these most especially is removal of felled or fallen Elm trunks, or boughs from infested trees. These, whilst the bark is still on, contain thousands of maggots, all steadily progressing to beetle state, in which they will fly to start new attack on the neighbouring trees. The grubs will thrive as well beneath the bark of the felled timber, so long as there is moisture enough for them to feed on, as if the trees were still standing; and to this most common practice of non-removal of infested wood is owing a great deal of the constant injury going on to some of the very finest of our park trees. Such neglected trunks may be seen in park land or rural wood yards in all parts of the country where I have had the opportunity of observation; and I have had no difficulty, by merely slipping my hand under the bark, in stripping off feet and yards of it swarming with the Elm-bark maggots in their galleries. Where this can be done nothing further is needed than to strip off the bark and burn it; or if poultry are at hand, and the bark can be thrown with the inner surface uppermost, even the trouble of destroying it is not necessary. The poultry will clear the grubs, and any that fall to the ground will perish. If the bark cannot be run off as above mentioned, infested patches may be easily cleared by rough-shaving off the bark down to the wood; or a good thick coating of pitch or tar applied to the bark would not be costly, and would save much risk of infestation from the beetles which would otherwise come out. To prevent attack of the beetles to standing timber is a very difficult matter. The mixture known as Leinweber's composition, for which the following recipe is given in Dr. Schlich's 'Manual of Forestry,' is said to be useful for this purpose:—"5 lb. of tobacco, mixed with half a pailful of hot water, are kept hot for twenty-four hours; the water is then squeezed out of the tobacco, and mixed with half a pailful of bullock's blood, one part of slaked lime, and sixteen parts of cow-dung. This is kept in an open tub, and stirred once a day, and used after fermentation has set in. The rough bark, moss, &c., is trimmed off the tree, and the latter painted with the mixture for three successive days until a crust is formed, which the rain will not wash off."* But besides the very disgusting nature of the appli-

* 'Forest Protection,' by W. R. Fisher, p. 250, being vol. iv. of Dr. Schlich's 'Manual of Forestry.' London: Bradbury, Agnew & Co., Bouverie Street.

cation, which would be repulsive to the operators, even if not prejudicial to health, there would be difficulty without the use of long ladders in managing to coat the trees with the mixture as high up as is needed.

A less objectionable mixture, known in Canada as the "Saunders' Wash," forms a tenacious coating on the bark, and is found serviceable there as a preventive of "shot-borer" beetle, serving equally to keep the beetles from getting in, or getting out. This is composed of soft-soap reduced to the consistence of a thick paint by the addition of a strong solution of washing-soda in water; and if applied to the bark of the tree during the morning of a warm day, will dry in a few hours, and form a tenacious coating not easily dissolved by rain. In a further communication, which Dr. Fletcher (Entomologist of the Experimental Farms, Department of Agriculture, Ontario, Canada) was good enough to send me on the subject, he mentioned:—"With regard to the soap-wash suggested for *Xyleborus dispar*, I have this year suggested the addition of carbolic acid, which I feel sure will have a good effect." A process was tried with success by our Botanic Society, so far back as the year 1842, which might be serviceable for saving special trees, but would hardly be applicable for work on a large scale. The plan consisted "in divesting the tree of its rough outer bark, being careful at the infested parts to go deep enough to destroy the young larvæ, and dressing with the usual mixture of lime and cow-dung."*

A series of French experiments based on the plan sometimes used of paring off the outer bark to restore vigour to bark-bound apple trees, and also on observations that where a vigorous flow of sap was brought about under Elm bark that many of the bark maggots were killed, were instituted as to the effect of having the whole of the rough outer bark of the Elm cut or shaved away. This operation caused a great flow of sap in the inner lining of the bark, and the grubs of the *Scolytus* beetle were found in all cases to perish shortly afterwards. Whether this occurred from the altered sap disagreeing with them, or from the greater amount of moisture round them, or from the maggots being more exposed to atmospheric changes, or any other cause, was not ascertained; but the trees that were experimented on were cleared of the maggots. The treatment was applied on a large scale, especially on Elms infested by *Scolyti* along the Avenue of Neuilly, the Boulevards, the Quai d'Orsay, &c., Paris, and the barked trees were found, after examination by the Commissioners of the Institute at two different periods, to be in more vigorous health than the neighbouring ones of which the bark was untouched. More than two thousand Elms were thus treated.†

* Details, with illustrations, were given in a paper read in 1848 before the Botanic Society.

† The above account is abridged from the leading article in the 'Gardeners' Chronicle and Agricultural Gazette' for April 29th, 1848.

But whatever plans may be tried for prevention of attack or ameliorating injury, the great point of all, which needs careful attention, is that infested Elm timber should not be permitted to lie about to breed beetles by thousands to fly abroad and re-infest the whole neighbourhood.

Serviceable information regarding this infestation will be found in the following publications :—

"Forest Protection," by W. R. Fisher, B.A. ; being vol. iv. of Schlich's 'Manual of Forestry.' London : Bradbury, Agnew & Co.

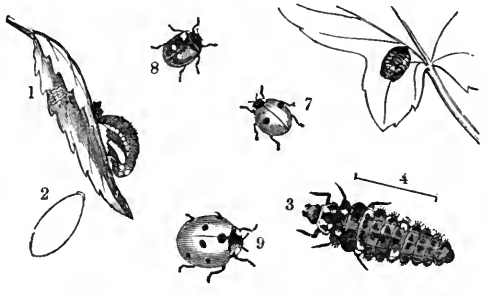
A paper by Dr. Chapman, published in the 'Entomologists' Monthly Magazine' for 1869, p. 126. London : Messrs. Gurney & Jackson, Paternoster Row, E.C.

'Praktische Insektenkunde,' von Dr. E. L. Taschenberg, pt. ii. p. 240. Bremen.

'Die Europäischen Borkenkäfer,' von W. Eichhoff, p. 148. Berlin.

LADY-BIRD BEETLES.

Seven-spotted Lady-bird. *Coccinella septempunctata*, Linn. ; and other species.



Coccinellæ.—1, cluster of eggs ; 2, egg, magnified ; 3, larva, magnified ; 4, line showing nat. length ; pupæ ; 7, Two-spotted Lady-bird ; 8, variety of same species ; 9, Seven-spotted Lady-bird.

The Lady-bird Beetles, and their slaty-grey, six-legged, and yellow-and-scarlet spotted grubs, are well known to all Hop-growers as rendering good service by lessening the numbers of the Hop Green Fly and Lice (scientifically, Hop Aphides) on the bines to a very important amount ; but they are not nearly so well known as they ought to be generally as sometimes doing equally good service in connection with common field crops as Turnips, Mangolds, &c., when

there is some especially bad attack of Plant-lice. Consequently the mischief that is being done by the Plant-lice is apt to be attributed to the very insects which are clearing the Plant-lice off, even to the extent of labour and time being given in careful destruction of the Lady-birds.

Last year I had enquiries as to the nature of Lady-bird infestation from widely distant localities, and as it is somewhat of interest to find it present on three distinct kinds of crops, namely, on leafage of Turnips; Mangolds; and also Tares, and Beans, I give the notes as follows.

The following observation was sent me, on July 23rd, from near Grampound, in Cornwall, on the part of a farmer, who, finding his Turnips perishing, and the very noticeable Lady-bird grubs in vast numbers upon the leafage, not unnaturally credited them with the mischief :—

"To-day a farmer showed me the enclosed insects; he has never seen them before. They are in thousands on his Turnips, and are, to use his words, cutting them to pieces. I should like to know what they are, why they come, what they do, and how to get rid of them?"

The accompanying specimens proved to be grubs of one of our large kinds of Lady-bird Beetle, and after a few days, on further communication and development of specimens, the infestation proved to be of larvæ (grubs) and beetles of our very common and handsome Seven-spotted Lady-bird, the *Coccinella septempunctata*.

On Aug. 11th the following note was sent me from a farm in the neighbourhood of Sandy, Bedfordshire :—"I am sending you a fly which I found in my Mangolds to-day; it has already done considerable mischief to them, and perhaps you will kindly tell me what it is."

In this instance the Lady-birds were still in the grub state, and with them were black aphides on the Mangold leaves, showing very plainly what it was that had brought their natural enemies; and a few days later I received the following communication, with larva enclosed, mentioning the presence of the Lady-birds also on the Beans, which, as is unnecessary to say, is a crop particularly liable to infestation of Aphides or Plant-lice. My correspondent observed :—

"I found some Lady-birds on some Beans close to the Mangolds, and I only took the one specimen of the insect I sent to you, as I thought I would wait till hearing from you about it before I did anything. Some of the Mangolds are badly attacked with the aphides, but perhaps some nice showers will wash them off."

On Sept. 4th the following note was sent me by one of my correspondents at Appleby, near Doncaster, which, it will be seen, shows the presence of Lady-birds in myriads as helpers to destroy the aphides on yet another kind of crop to those previously mentioned :—

"I have been on the wolds near Grimsby this week, and the lambs are put on Tares and Rape. The Tares are simply covered with filth, and millions of Lady-birds have come to them. A net-stake was covered, and they are on the gates all over. I never saw so many."

On Sept. 15th my correspondent wrote further, in reply to my letter on the subject:—"I sent at once to the place where I saw the filth on the Tares, but the rains have killed them."

Below I give extract from letter in answer to my enquiry:—

"The aphides on the Tares are all gone, the late heavy rains and colder temperature having killed them. The Lady-birds are to be seen dead in great numbers on the Tares, their *pabulum*, the aphides, having failed them. One of our greatest long-wool ram breeders refused to put his young rams on his Tares, owing to the excessive filth."

The following note by the late well-known coleopterist, Mr. E. C. Rye, is of interest in connection with these vast appearances of Lady-birds:—

"They have been observed in the southern counties to follow the aphis in swarms, unexpectedly making their appearance by thousands, and settling upon every available resting place; indeed, I have known them to occur in such numbers that it has been necessary to sweep them away from paths and windows. They fly strongly, but are not rapid or strong walkers. . . . The patches of small yellow eggs can often be seen deposited by the parent insect on plants infested by aphides; and the slaty-blue larvæ, which are tuberculated and spotted, contracted behind, and with six conspicuous legs in front, may be observed crawling about shrubs in gardens, or on walls, preparatory to the change to pupa, which is fastened by the tail, and does not get rid of the skin of the larva."*

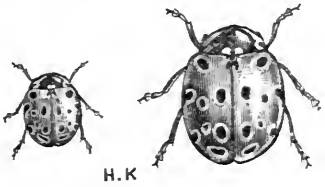
The genus *Coccinella*, to which these beetles belong, does excellent service by destroying Aphides or Plant-lice, both in the beetle state, commonly known as the Lady-bird, and also (and to a still greater extent) in the grub or larval condition, sometimes known as "niggers." The eggs soon hatch, and the grubs feed (on the aphides) for about a fortnight or three weeks; they then change to the chrysalis or pupal state, from which the beetles appear also in about a fortnight or three weeks' time. The late broods pass the winter in beetle state in any convenient shelter, as crevices of palings, under bark, amongst loose leaves, or in buildings, or dwelling-house, and are ready with the return of warm weather to lay eggs and start a new generation.

The *Coccinellæ*, which are more especially known as Lady-birds, are small beetles, hemispherical in shape, convex above and flat below,

* 'British Beetles,' by E. C. Rye, p. 228.

with a short transverse thorax, and short clubbed antennæ. The length varying in different species from hardly a sixth of an inch, as in the case of the pretty little lemon-yellow kind, with twenty-two black spots, to our largest species, the Eyed Lady-bird, which is from a third to nearly half an inch in length.

The two commonest kinds are the Seven-spotted, *Coccinella septempunctata*, and the Two-spotted, *C. bipunctata;* both kinds black, with



Coccinella ocellata.—Eyed Lady-bird, natural size and magnified.

bright red wing-cases spotted with black in the numbers conveyed by the names, but the *bipunctata* is very subject to variation in colouring.

The Eyed Lady-bird, *C. ocellata*, is a very handsome insect, with black head varied with white markings; thorax (fore body) black, margined with white in front and at each side; the wing-cases reddish, with eight black spots ringed round with pale yellowish colour on each. This kind varies in its markings, and infests Fir and Pine, but Stephens mentions it as also found on Beech; and the specimen figured, which is the only one I have received, was found on a Hop leaf belonging to a white bine (or old "golding") growing in an old hop-yard in the parish of Yalding, Kent, which kind, I was informed, was peculiarly liable to attack of Green Fly.* Anyway, even the passing presence of this great kind of Lady-bird on the Hop is perhaps worth record.

Another kind deserving a word, though not strictly a *Coccinella*, is the Minute Black Lady-bird, the *Scymnus minimus* of Rossi, of which specimens were sent me on August 5th, 1893, from Canon Court, Wateringbury, Kent, by Mr. Edw. Goodwin, as doing good service in grub state by preying on Red Spider on Hops; and it was again noticed to some degree in the following year.

This very little beetle is like the common Lady-birds in shape, but hardly the twelfth of an inch in length, black in colour, with the wing-cases *slightly downy*. The maggots, when fully grown, are hardly the eighth of an inch in length, and, as seen by the naked eye, of a smoky grey colour; with a two-inch focus object-glass they are of a smoky yellowish colour, with black markings. The maggots, as well as the chrysalids, are similar in shape to those of the common Lady-bird.

* See my 'Eighteenth Annual Report on Injurious Insects,' p. 72.

In maggot state these *Scymni* appeared perfectly voracious, and certainly did not confine themselves to Red Spider on the Hop leaves, for, on placing them on Plum leaves infested with Red Spider, they began to feed almost immediately, and continued at the work steadily. Failing other food they devoured each other, in one instance under my observation, until only one survivor remained, which went through its changes rapidly. On August 28th it was still in larval state, and after changing in the usual manner of the Lady-birds to a pupa (in this instance shiny and black), hung up by the tip of the tail, I found, on September 6th, the little Black Lady-bird walking actively about.

From the good supply of specimens sent me, I was able to watch the development of this useful little creature from the larval to the beetle state, and gave the observations in detail in my Seventeenth Annual Report, as I am not aware of the history having been noted previously.

The only method in which artificial measures appear reasonably practicable in gaining help from these various kinds of Lady-bird Beetles and their larvæ is by their appearance being so generally known that when they are observed in the vast numbers in which they come at times to aphis-infested field crops, they may not be *purposely* destroyed as field pests. I have been consulted about them, with the information accompanying that they were being hand-picked as destructive, and, though there is no danger of this happening in the case of Hop fields, in other cases it may save harm to draw attention to their services being beneficial.

As yet (so far as I am aware) we have not any examples of Coccinellid beetles being injurious in this country by feeding on leafage. But various species of Lady-birds of this family, of the genus *Epilachna*, do notable mischief as vegetable feeders. Of these two species are recorded as injurious in the United States—one the *E. borealis*, the other the *E. corrupta*. Both of these are good-sized beetles (the *borealis* in the figure before me is well over a quarter of an inch in length), hemispherical (like our own Lady-birds) in shape, and yellow in colour with black spots.

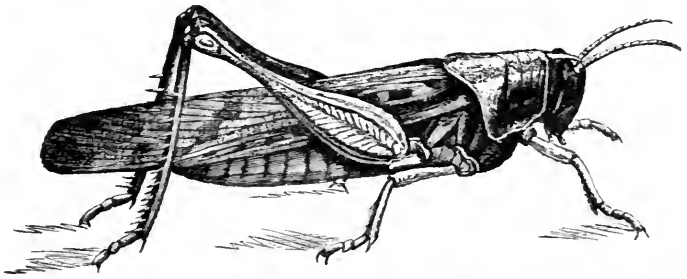
The larvæ are also yellow, of a long oval in shape, and with long and branched spines. The above characteristics make them perfectly distinguishable, both in beetle and grub state, from our own helpful Lady-birds.

The *Epilachna corrupta* is injurious to Beans, both to leaf and pod; but as it is especially reported as present in the west and south-west of the United States, it seems unlikely that this kind should trouble us here. The other species, the *E. borealis*, is found in the more northerly and easterly States, and attacks the leafage of Cucumber,

Melon, and similar plants;* and as the climate here might allow of its presence, at least as an infestation of plants under glass, a few words of description may be of service.

LOCUSTS.

Migratory Locust of South America. *Acridium* (*Schistocerca*) *paranense*, Burm.



ACRIDIUM (SCHISTOCERCA) AMERICANUM, after Riley, North American Migratory Locust (see p. 54 for likeness to South American species).

On May 28th the following note was sent me by Mr. Geo. Barton, manager to Mr. John Cox, cowkeeper, &c., of 112, 114, and 116, Harris Street, Camberwell, S.E.:—"The enclosed specimens are arriving in bales of hay from South America; would you be so kind as to tell me what they are?"

On examination, the insects proved to be specimens of the "Migratory Locust" of South America, scientifically *Acridium* (*Schistocerca*) *paranense*, Burmeister, the same species of which specimens were sent to me in 1893 from a Liverpool firm, with the enquiry whether the insects, which were found in quantity averaging one Locust to a pound of the Alfalfa (Lucerne) hay which was then (February 2nd) being landed from Buenos Ayres, were injurious to horses or cattle if consumed in fodder.

I was unable to offer any information on this point, and advised procuring a proper veterinary opinion, as, on the face of the thing, it seemed very possible that the hard, horny, and spiny shanks of the hind legs of the Locusts might cause mischief; but I did not hear of illness either in this case or in the case of specimens of the same kind

* 'Economic Entomology,' by John B. Smith, Entomologist o the New Jersey State Board of Agriculture, p. 175. Philadelphia, 1896.

of Locust sent me in the beginning of September in the same year on the part of a farmer in the neighbourhood of Caversham, Oxfordshire, who wrote me that he had just purchased some foreign hay, and found quantities of Locusts in it to the amount of not less than two hundred specimens in one truss. For details, see my 'Seventeenth Annual Report,' pp. 47–53.

In the past season, however, as some illness occurred in consequence of (or, at least, in coincidence with) some horses feeding on Locust-infested fodder, it may be of interest just to mention the circumstance.

On June 2nd Mr. Barton sent me a packet containing one hundred and sixteen Locusts, now shrunk and flattened and out of shape from being closely packed in the Alfalfa, but which, when fresh, would have been about the size of the exceedingly nearly allied, if not identical, species the North American Migratory Locust, the *Acridium* (*Schistocerca*) *americana* of Drury, figured at p. 53, and with these, fragments of other specimens of the same kind, and the following note accompanying:—

"I am sending you specimens promised. The whole are the contents of two bales of Alfalfa of Buenos Ayres, each weighing about 1 cwt.; in some bales there are scarcely any specimens, but in others large quantities. They seem to congregate in swarms."

In regard to horses, Mr. Barton mentioned that the first of the three employed, one evening showed signs of colic and inflammation, and the next morning another horse was attacked; and Mr. Barton observed that he "thought it rather curious, so overhauled the food, and discovered the Locusts; at once changed the hay, substituted bran for a day," and the illness vanished. During this time the third horse was taken ill with exactly the same symptoms. One noticeable feature in the symptoms is that the animal stands with tail straight out, and legs stretched out to the fullest extent, and continually looks round to his flanks. On June 22nd Mr. Barton further mentioned that this horse "was very low for a week, but no doubt bran-mashes and a drench every six hours would account for that, since I have noticed no difference whatsoever; the animal seems quite well."—(G. B.) Mr. Barton mentioned that he was feeding cows with the infested Alfalfa, and could not see that it affected them in the least.

The above observation may possibly be of some interest in connection with the importation of Alfalfa from a country so greatly infested with Locusts as the Argentine districts. I am not able myself to judge, as I in no way understand or study veterinary matters; but having been previously asked whether I knew of illness occurring in connection with consumption of infested fodder, I just

give above the main points of the notes with which Mr. Barton favoured me.

The figure of the North American Migratory Locust at p. 53 gives as good an idea of those of South America as if taken from one of them. The colouring of the specimens sent me was: head mottled, of various tints, including reddish pink; the thorax striped lengthwise above with various shades of yellowish brown and deeper brown, or with deep brown striped with a still deeper shade; hind shanks coral red with white spines, black at the tips. The narrow parchment-like upper wings have a pale narrow stripe at the fore edge, and also for rather more than half the length at the hinder edge, with an area between the two stripes, narrow at the base and gradually widening, marked with angular brown blotches, these dark near the base, and fainter towards the tip of the wing. Beneath these elytra or upper wings are folded a pair of large wings of delicate transparent tissue.

With regard to the precise name of this destructive South American Locust. On first receiving specimens, I forwarded samples to Señor Don Ignacio Bolivar, at Madrid, in order to be absolutely certain on the matter, and he was good enough to examine and confirm my identification, mentioning that it was "without doubt the *Acridium* (or rather the *Schistocerca*) *paranense*, Burm., which causes much ravage in southern parts of America." It may also be of some interest to note that in the First Report of the U.S.A. Entomological Commission it is mentioned that there is so little difference between the *Acridium americanum*, or Migratory Locust of North America, and the *Acridium peregrinum*, the migratory species of South-western Asia and North Africa, that ordinary observation would scarcely find any difference between the two. Also various writers consider that the *Acridium peregrinum* does not really differ from the *A. paranense* of the Argentine Republic; and in published observations placed in my hands during the past season regarding the local investigations of this serious agricultural pest of the Argentine Republic, I notice that the name adopted is *Acridium peregrinum*.

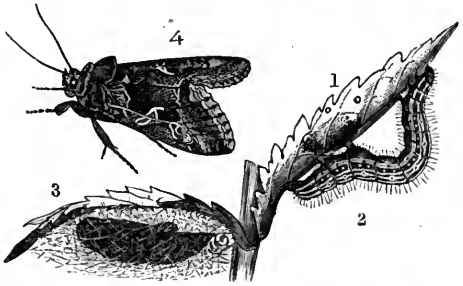
The details of the investigations are not of practical agricultural interest here; but on June 2nd I was favoured by a visit from Mr. Hy. Watts, Secretary of the South American Land Company, and Mr. J. D. Lyon, of the Estancia Trenel, manager of about 120 miles of land about 350 miles west of Buenos Ayres, and Mr. Lyon at once recognized the specimens sent me by Mr. Barton as the same kind which was so exceedingly injurious in his part of the country, where he mentioned that they had now been prevalent for seven years; and to give some idea of the wide area of infestation, he mentioned on one occasion riding through the great swarms or flocks of Locusts for about twenty miles, and a friend continuing the observation for

nineteen miles more, thus showing thirty-nine miles of continuous presence of Locusts.

As, from all observations up to date, it seems to be proved that Locust attack cannot establish itself in this country, it is unnecessary to enter on means of prevention and remedy.

MANGOLD.

Silver Y-Moth. *Plusia gamma*, Linn.



PLUSIA GAMMA.—1, eggs; 2, caterpillar; 3, chrysalis in cocoon; 4, moth.

This pretty moth, which takes both its popular and scientific name from the silver marking in the shape of the English letter Y and the letter in the Greek known as gamma, on the fore wings, is very widely distributed in England, Scotland, and Ireland, and often observable in summer and autumn, sometimes in great numbers, although it is only occasionally that it does much mischief with us.

Last season, however, towards the end of the summer, this infestation did a deal of harm to Mangold leafage at a locality in the County of Kerry, in the extreme south-west of Ireland. Specimens of the cocoons were sent me, from which I found the first moth developed on September 11th; and two days afterwards I was favoured by the following observations from Prof. P. Hedworth Foulkes, of the University Extension College, Reading:—

"I have just returned from a tour in Ireland, and while there came across, in Co. Kerry, a very serious attack on Mangolds of what I now find to be the *Plusia gamma*. . . . We managed to find a few pupæ, which we sent to you. The attack was over, but the damage done was very apparent, and but for the abundant supply of rain I doubt whether there would have been a crop at all. I have never seen anything like it, and I believe I am right in saying that this

insect seldom does any damage in this country. Of course abroad we know that Beet is very liable to severe attack."

On October 1st Prof. Foulkes, at my request, favoured me with a few more observations:—

"The field contained about fifteen acres of Mangolds, and was part of the home farm of Sir John Colomb, two or three miles out of Kenmare; the damage done by the pest would have been more apparent earlier in the season than when seen, *viz.* September 1st, as the August rains had no doubt saved the crop. Prof. Carrol and I estimated the damage then to mean a loss of about fifteen to twenty per cent. of the crop. If the crop had been in a dry district, I should very much doubt there being a crop at all. We found a few caterpillars still feeding, and I have wondered whether these could be a second brood. The pupæ found were enclosed in strong net-work cases on the under side of leaves, and seemed capable of standing excessive moisture. I should be glad to know whether the pupa stage is ever passed below the surface of the soil; I ask this because we searched well the leaves, but only found a few pupæ, nothing like what we expected to find with so much damage. Neither was this due to the (shall I say) lateness, because we should in this case have found the remains of the cocoons upon the leaves."

Prof. Foulkes' enquiry is one of very practical interest, but it does not appear that this moth does pupate under ground. The caterpillars by no means necessarily spin up on their food-plants; they are stated to form their cocoons on "any plant," and we had a good example of this in an observation sent me on October 3rd, 1883, by Mr. Geo. Brown, from Watten Mains, Caithness, N.B., where he had noticed caterpillars, which turned out to be those of the *Plusia gamma*, doing much harm to Turnip leafage. Amongst the specimens sent were some moth chrysalids in web cocoons, with the note: "Corn crops are perfectly covered with these cocoons; beneath the sheath-leaf and stalk in the corn, in the seed-stalks of Sorrel, and on every and all parts of the Field Thistle the cocoons appear"; and a little later on more specimens were sent, which showed the infestation to be of the *P. gamma*, the Silver Y-Moth.

This moth is widely distributed, and often noticeable in summer and autumn flying about flowers in the day-time. The fore wings, which are upwards of an inch and a half in expanse, are of a satiny glance varied with brown and grey markings, and sometimes with a purplish or coppery lustre, and in the centre is the pale or silvery marking like the letter Y, from which the moth takes its name. The body is smoky colour, and so is the ground colour of the hinder wings, but these are sometimes of a whitish colour across the centre, "leaving a broad brown margin; the fringe is whitish, with a line of blackish

spots." Of this moth John Curtis says there are two broods yearly; customarily (according to foreign observation*), the half-grown caterpillars live through the winter, and apparently the moths occasionally do so, as they have been found at the beginning of May. The eggs are generally laid beneath the leaves, singly or in clusters, as the case may be, and soon hatch. The caterpillar, when full grown, is green, covered with short hairs; the head brownish green; six white or pale lines along the back, and a yellow line along each side. It has three pairs of claw-feet, and *two* pairs of sucker-feet or prolegs beneath the body, besides the pair at the end of the tail, which are green and fleshy; and, consequently on having the two pairs of sucker-feet, it is what is called a "half-looper" caterpillar (see figure 2, p. 56). It raises itself in a loop when walking, but not as high and complete a loop as is characteristically formed by caterpillars with only *one* pair of abdominal sucker-feet.

A "probably hitherto undescribed form of the larva" is mentioned by Mr. Geo. Porritt† as having been sent him by Mr. C. Whitehead in July, 1892. These specimens were smaller than the ordinary form, only an inch in length at full growth; the ground colour dark olive green,—in one specimen nearly black; head and prolegs intensely black and shining (for full description see reference). Of these only a moderate proportion (half the number or so) appear to have spun, and of these again a very small proportion of the chrysalids produced the moth, but enough to show that though very small, less than half the size of ordinary specimens, with which they were compared by Mr. Porritt, and also paler in colour, there was nothing to distinguish them from the true *P. gamma*.

When full-fed the caterpillars spin a white woolly cocoon, either in the folds of a leaf or on some plant, and in it they change to a black or pitchy chrysalis (see figure 3, p. 56).

The caterpillars appear to be very general feeders, including in their food-plants leguminous crops, as Peas, Beans of different kinds, and Clover, also Turnip and Cabbage leafage, also Lettuce, Beet, and Mangold leafage, &c., and have also been known to attack Oats. Amongst weeds they have been found to attack Thistles (*Carduus*), Burdock (*Arctium*), Nettles (*Urtica*), and also grasses.

The species appears to be more or less present every year during summer and autumn, and sometimes very abundantly, as, for instance, in 1892, when Mr. Geo. Porritt observed, on September 8th (see reference above), that on the Lancashire coast the moth was flying in thousands a fortnight previously.

* See 'Praktische Insektenkunde,' of Dr. Taschenberg, pt. iii. p. 154.

† See 'Larvæ of British Butterflies and Moths' vol. vi. pt. iii. p. 112. London: Ray Society.

But as a really destructive infestation of our crops it is rarely mentioned, the great exception being the memorable immigration into this country in the year 1879, in which the swarms left North Africa in April, and, after traversing Europe, and doing plentiful mischief by the caterpillar infestation they gave rise to by the way, they arrived on our south coast early in June, and the moths were subsequently observable throughout England, Scotland, and Ireland.* The caterpillars did great mischief in various places; but it is worth notice that, notwithstanding the great prevalence of the infestation in 1879, in the the following year it was merely reported as being noticed in small numbers and in few localities. One very especial example of this was at Exeter, where, in 1879, Mr. Edw. Parfitt (who was a skilled entomologist) mentioned that he "never saw anything to be compared with its numbers; towards the end of September the larvæ literally swarmed on every garden plant, defoliating the plants, as well as riddling the leaves"; and in the following year Mr. Parfitt observed that up to the 17th of September not a single specimen had been seen in the neighbourhood of Exeter.

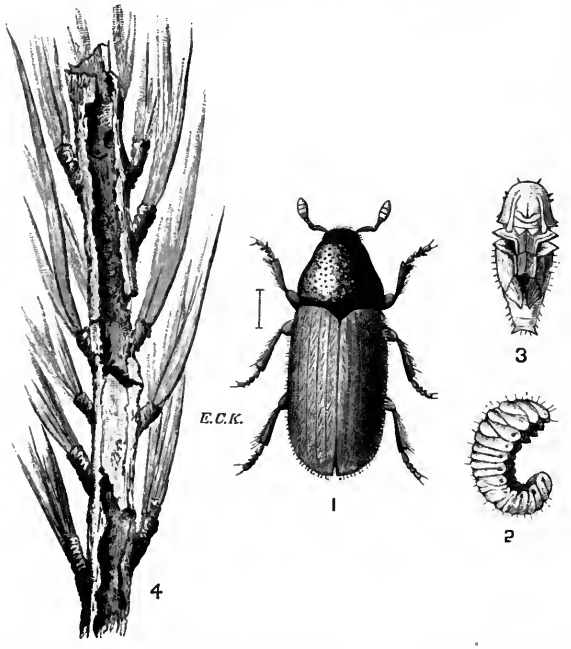
Prevention and Remedy.—As this attack so rarely occurs, measures of preventing it seem hardly to require to be entered on. Still it would perhaps be desirable where cocoons are noticed in the great numbers mentioned at p. 57, to have these collected and burnt. This small amount of trouble would ensure that there should be no recurrence of attack, in whatever state the infestation may pass the winter with us, from development of the contained chrysalids.

In garden attack, dustings with lime and the customary deterrent dressings would be sure to be beneficial; and as the caterpillars are large, hand-picking might be a very serviceable remedy at no great cost; also, as the caterpillars appear very sensitive to the effects of wet, heavy washings or syringings of cold water would be likely to get rid of many of them.

* For many details and dates of observation, for which I was obliged to Mr. E. A. Fitch, F.E.S., of Maldon, Essex, see, amongst other contemporary records, my own Annual Report for 1879.

PINE.

Pine Beetle. *Hylurgus piniperda*, Linn.



HYLURGUS PINIPERDA.—1, beetle; 2, larva; 3, pupa,—all magnified, with line showing natural length of beetle; 4, Pine shoot tunnelled by beetles.

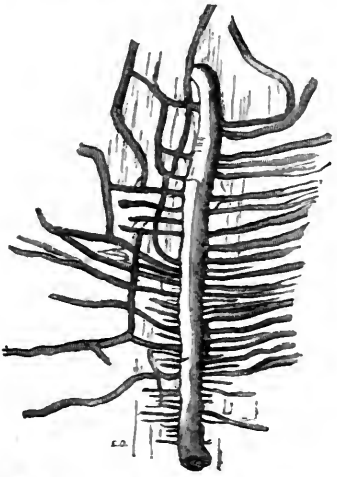
In 1896, attention was very forcibly drawn by various correspondents to the serious amount of injury which was being caused by the "Pine Beetle" in various districts in Scotland, notably in parts of Forfarshire, and in the neighbourhood of Montrose, and likewise (in England) near Redditch, Warwickshire; this great presence of the pest being especially noticeable where Scotch Fir was blown over by the gales of recent years, and (often almost unavoidably) allowed to lie where it fell. These blown-over or injured trees, or the boughs thrown down by the gales, become the breeding-ground of the Pine Beetles, which propagate, and continue by successive broods to propagate yearly, between the bark and wood of the trees or boughs, in which the full flow of sap is thus checked, until it has become too dead and dry to afford sufficiently juicy food for the multitudes of growing maggots.

The observations sent regarding the widely spread and great amount of presence of this timber pest in 1896 in absolute sequence

with the occurrence of great gales of very recent years were of much practical interest as confirming on a very broad scale the principle laid down in all good forest practice, that, to prevent infestation of Pine Beetles, their nursery-grounds should not be allowed to exist.

But in the past season, such special further observation has been made of injury by Pine Beetle attack occurring over a large area in connection with many thousands of trees being blown down by the gales of 1893 and 1894 that the subject is worth reference to again as showing how the effects of these great gales not only cause present loss of much timber, but, if not attended to, lay the foundation of a successive yearly destruction to a very serious amount.

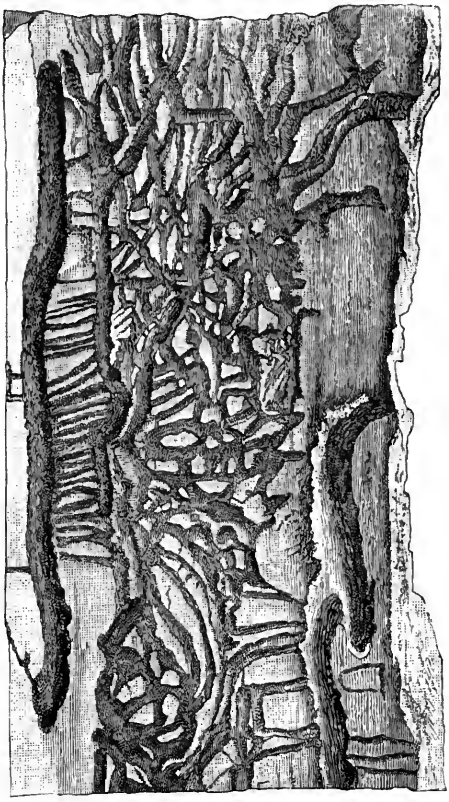
The worst attack, it will be seen, was on the great Haddo House property near Aberdeen, on which Mr. J. Clark (forester) is purposing to set on foot carefully considered measures to check the progress of the infestation; but to those not fully acquainted with the Pine Beetle and its life-history, the following short account may usefully precede Mr. Clark's notes, to show the reasons of his proposed operations.



Mother beetle and larval galleries.

The damage done by the beetles to the shoots of the Pines, and the numbers of these which are found on the ground beneath the Fir trees, or perishing upon them consequently on the central part having been tunnelled away for some inches in length by the beetles, is what usually draws attention to the presence of the attack. But it is not in these burrows that the beetle lays its eggs and the maggots feed. The regular course of operations is for the beetles to appear in April and May, and the females then bore their galleries by piercing a little hole through the bark of boughs, or young trees lately felled, wind-fallen timber, &c., and there each female gnaws a tunnel just below

the bark, and lays her eggs along each side of it. The maggots soon hatch, and each maggot gnaws its own tunnel somewhat at right angles to the mother gallery (see figure, p. 61), and when full fed, which is towards July or August, they turn to pupæ at the end of their galleries beneath (or in) the bark, where the beetles complete their development, bore through the bark, thus causing the shot-like holes so observable in bark of infested trees, and then fly to growing shoots,



Inside of Pine bark, showing tunnelling of Pine Beetle and maggot.

which they tunnel and destroy, but only use as shelter, not for places of egg deposit. The beetles come out from the timber about the middle of the summer, it may be from the end of June until the end of August.

The larva or maggot of the Pine Beetle (*H. piniperda*) is about a quarter of an inch long, fleshy, wrinkled across, and legless, largest in the rings behind the head (see figure 2, p. 60); the general colour white, but ochrey near the head, and also somewhat ochrey in tint towards the tail; head dull yellowish.

The Pine Beetle is about the fifth of an inch in length; pitchy or

black; wing-cases rather lighter in colour, somewhat rough, with rows of fine punctures, alternating with rows of little bristle-bearing tubercles (these absent on the apical portion of the second interstice). Fore body somewhat smaller in front, and (as well as the head) punctured; antennæ clubbed at the end, and, as well as the feet (tarsi), rusty red, or brown, or yellow brown (see figure 1, p. 60).

In the early stages of the infestation to the tree or bough, before the tunnellings of the successive attacks have become confused together, the mother gallery and the side maggot galleries are quite clearly distinguishable, as shown in figure, p. 61. Later on, where many perforations like shot-holes are noticeable outside the Pine bark, showing for the most part the exit holes of the beetles which have been developed within, it is probable that the bark can easily be split from the wood, consequently on the quantity of workings between the two, and the galleries will be found interlacing and crossing, as shown in the figure on p. 62, which I copy, with acknowledgment, from a portion of the illustration given by Herr Eichhoff in his valuable work on European Bark Beetles.*

Figure 4, p. 60, shows the appearance of a beetle-infested shoot cut open lengthways to show the tunnelling within. Sometimes these burrows are only an inch in length, and only one in a shoot; sometimes there may be several tunnels, each made by a separate beetle, with a short length of uninjured wood (as figured) between each, occupying altogether, as in one of the worst attacked shoots that I have seen, as much as six and a half inches. This attack affects the shoots of the current year (occasionally the beginning of the boring is made just below the beginning of the *then* present year's growth), and besides the general damage done there is very special injury and loss of value if the central shoot of the young tree is tunnelled, and its growth becomes bushy-headed.

Where much attack has been going on, the yellow or dying shoots on the trees and the numbers of fallen shoots beneath, with more or less beetle presence in them, will attract attention. But, excepting so far as the beetles may shelter in or about them for the winter and renew attack at egg-laying time in the following spring, the mischief here is completed. Gathering up the fallen shoots and destroying them will save some risk of further infestation if the beetles are still in them; but where the battle really has to be fought to prevent serious recurrence of attack is in the infested trees and branches, where the nursery-ground of the maggots and beetles is to be found in or just beneath the bark.

The following account, sent me on September 23rd by Mr. John Clark (forester), from Kelly, Haddo House, near Aberdeen, N.B., it

* 'Die Europäischen Borkenkäfer,' von W. Eichhoff. Berlin.

will be seen exceeds in amount of damage calculated to have been done by excessive gales of wind even that reported to me by Mr. Lambert, from the Hewell Estate Office, Redditch, Worcestershire, in 1896, of which he mentioned:—"One half of this plantation, containing several thousand trees, was blown down by the great gale of March 25th, 1895. It took us many months to cut out the trees, which were all piled one on another."—(L. F. L.) In both cases, as was to be expected, destructive attack of Pine Beetle followed.

On September 23rd (1897) Mr. Clark wrote as follows:—

"On this estate the Fir woods have been suffering very much during the past three years from the attacks of *Hylurgus piniperda* consequent on the gales of 1893 and 1894. Those gales threw down about one hundred thousand trees, most of which in the course of one year after were in the very best condition for Pine Beetle nurseries, and the quantity bred during the past three years has been enormous, which you will understand when I tell you that they have entirely destroyed hundreds of acres of old and young woods. Over one thousand acres of Fir woods have not within them a single tree that has not been attacked by Pine Beetle. I am now preparing to make a great effort to reduce this pest during the coming season. . . . I have made a careful study of the beetle, and watched its course of operations during the last two years, and I am convinced that the most successful plan of beetle destruction is to prepare nurseries for breeding, and destroy them in the nursery."

Mr. Clark's view as to "trapping" by placing wood in a condition for infestation to attract egg-laying, and then destroying the infested wood before the beetles' time of escape has arrived, is one that has been strongly advocated; but we have not yet had report of such broad-scale attacks as to furnish a sufficient amount of growing timber brought, as Mr. Clark proposes, artificially into ill-health to have information as to this especial form of experiment, and it will be of great interest in the welfare of Pine preservation to watch its results. Mr. Clark's plan is as follows:—

"I propose to remove six inches of bark at the surface of the ground from those trees which I intend to be nursery trees, and this will bring the trees thus treated into condition for the beetle as nursery ground. I have satisfied myself that neither a healthy tree nor a dry tree is of any use to the Pine Beetle, but the sick or languishing tree is exactly the conditions it requires for nurseries." [This quite agrees with the adopted views.—E. A. O.] "Where I have not trees to spare as trap trees, I will get trap trees from other woods. I propose to begin preparing trap trees in the beginning of February, 1898, as I will require to put down fresh trap trees once a month for four months. I have found that some trees are good as

nurseries for the whole summer, but it will be necessary to take down the trap trees before the young beetle begins to escape. I found young beetles fully developed by the beginning of June, so that my first set traps will require to be taken down, stripped of the bark, and burned by the first of June, and the beetles that escaped, or that have not begun to breed, will find the traps prepared in March in condition for them, and they seem to have no difficulty in finding out the trees that are in condition for them."—(J. C.)

The following notes from Mr. Clark's report give some of his personal observations as to winter habitat of the beetles which have been boring the Pine shoots, and it will be noticed that he doubts whether hybernation of beetles does (as has been sometimes stated) take place "amongst fog" or "forest rubbish." Possibly this may depend on local conditions. I have never had the opportunity of investigating the point myself, and Mr. Clark being evidently a very careful observer, I give his observations on this point, and also on the holes giving exit or access to the mother beetle's tunnel, *verbatim*, precisely as he favoured me with them :—

"I think the beetle can only live in winter when it is comfortably housed in the annual shoots of the Fir tree. I have never seen them 'amongst fog' or 'forest rubbish,' and as far as I have been able to follow them, they live only in the annual shoots or the twigs of one year's growth from September till April. In the beginning of April many of the beetles leave their winter home, and make fresh attacks upon other twigs. About the middle of the month they appear in pairs on the nursery tree, when they make their way under the bark together, and cut out the hatching tunnel from three to five inches long. The tunnel is usually slightly curved at both ends. Between the entrance hole and the escape hole they usually make two other holes, and sometimes only one; at other times three or four. These holes are made from the tunnel outwards to about one-sixteenth of an inch of the outer surface of the bark, making an opening out less than half the diameter of the hole, and this little opening has threads of bark left over the mouth of it. The purpose of the hole seems to be to admit air and keep out all enemies during the time the eggs are hatching. The entrance hole is closed, and so also is the exit hole. I have not been able to follow the old pair after they leave their first nest. I have found from fifty to one hundred and fifty grubs making their way from the sides of the breeding-tunnel. The perfection of the tunnel can only be seen before other pests find their way into it.

"There are a great host of followers, whose names I do not know, who feed on the deposit, the decaying matter, and often on the pupa. I compute that one average-sized nursery tree in the best condition produces about twenty thousand young beetles.

"Where the bark is more than one-quarter of an inch in thickness, I find that the transformation bed is always on the surface of the wood and immediately under the bark, and in the process of change from pupa to beetle the little body sinks about one-sixteenth of an inch into the solid wood. If the bark is over one-quarter of an inch in thickness I find that the grub makes its transformation bed about one-eighth of an inch from the outside of the bark, where it is safe from all enemies, and the young beetle has little trouble in cutting its way out. . . .

"I have found the squirrels doing good service by eating the grub of the *H. piniperda*. Hundreds of trees have been stripped of their bark since the month of June, but they can only find them where the bark is thin. When they are found under the bark, it is a pity that they cannot find them in the bark; as it is, I believe they have destroyed nearly one-half of the beetles that have been bred during the past summer. From twelve to fifteen feet of the lower part of the stem they do not touch. The squirrels thus mark the trees that are ready to be removed, and the bark burned."

Mr. Clark's observations were accompanied by plentiful specimens, including both attacked shoots and infested bark.

The following notes, with which I was kindly favoured by Mrs. Fleming Hamilton, of Craighlaw, Kirkcowan, Wigtonshire, N.B., refer, like the preceding observations, to injurious attack of Pine Beetle following on injury from the Pine woods having been blown down, but are of special interest as showing yet another branch of the subject. In this case it is the *young* Firs planted to take the place of those destroyed by the gales of wind which are being attacked. On October 15th Mrs. Fleming Hamilton wrote me as follows:—

"I am very anxious to ask your advice about some young Fir trees which are being destroyed by a beetle. Some ten years ago all our woods were blown down by the very severe gale. We have planted again lately, and the Firs seemed to be going on all right till a short time ago, when we noticed the tops of many dying, as well as other branches. This was principally in Scotch Fir. . . .* On cutting off the affected parts, we found beetles had bored their way in and out at the top, thus thoroughly destroying the tree. Can nothing be done to destroy these pests? either painting with any solution or any other ways, as it seems likely to attack all the young trees in the plantations, a very great loss to us, just as they were beginning to get on."

On October 25th Mrs. Fleming Hamilton favoured me with specimens of the good stout Pine shoots which were being injured, together

* Caterpillar attack was also present, presumably of Pine-bud or Pine-shoot Tortrix Moth, but this we did not enter on.

with some of the Pine Beetles, *Hylurgus piniperda*, and a few more observations:—

"The forester tells me he finds them most in the young, and generally in the top, shoot. There are maggot-workings and maggots in the fallen trees, and he has found them under the bark of standing trees, but very rarely. The forester thinks the beetle mostly works its way straight up, not into side and little branches."

The above-mentioned attack formed a most complete example of the permanent character of the infestation when once established, and likewise of the great injury to the value of the young trees by the destruction of the leading shoot.

The reports of the past season and of the previous year, when taken together, give a truly broadscale example of the great loss which is frequently going on when not made the subject of careful investigation (as it was in the above instances).

Prevention and Remedies.—Clearing away infested shoots from the trees where they can be reached, and from beneath them, where the shoots have fallen, gets rid of some amount of the beetles, but not of so many as might be expected, for the beetles (as may be seen by splitting an infested shoot open) are lively and active, and very well able to remove themselves on being disturbed; they are apt at a touch to the branch to "back out of their tunnels and fall to the ground." Therefore in the case of cutting shoots off infested trees, if they are simply cut into a basket, most likely most of the beetles will escape; but they should be put in some kind of bag, out of which the beetles are not likely to make their way, and the contents should be emptied out and burnt as soon as the bag is full. How far it would be worth while on a large scale of work to remove the fallen shoots would be best judged of by opening a few dozens in different places, and seeing whether the beetles are still within; but though opinions differ as to the beetles hybernating in "fog" or "forest rubbish," still a general clearance and burning of all this, together with the fallen shoots, would certainly remove a very likely shelter of infestation.

But *the great point of prevention* is to remove, as soon as possible, all fallen trees or boughs in which the beetles can establish their nursery-grounds (as previously mentioned) between the wood and bark. And not only this, but all slabs of Pine, or pieces of wood with the bark on, which are trimmed off where young Fir plantations are thinned, should by no means be left in the plantations, but should be gathered together and burnt. If there is no bark on the wood the rubbish is harmless as a breeding-ground. "When Fir thinnings are carted from the plantations, it is a very common practice to dress the

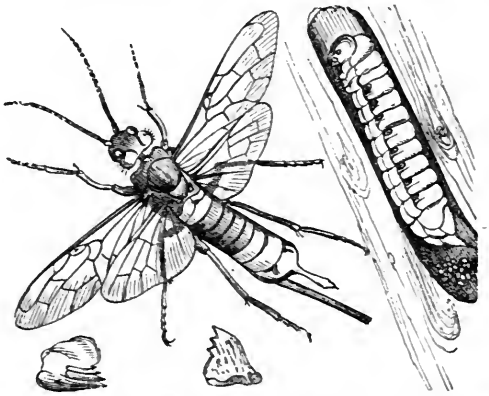
bark off to lighten the carriage in transit to market. The dressing-off of the bark should not be permitted within the plantation; in a year after, the ground round these heaps of bark may be seen covered with brown shoots blown from the growing trees, bored by the beetles which the heaps have nurtured."*

Where attention can be given to *trapping*, some of the slabs and trimmings may be utilized for this purpose. The pieces of waste wood with the bark on may be laid, if of some size, bark uppermost, on the ground, or supported against a tree, and before the time for development of the beetles arrives, they can easily be collected and burnt. But it should be well seen to that operatives who may beg the waste material for firewood do not simply stack it and keep it to suit their own convenience for burning, in which case all the trouble of preparing the "traps" will have been of no use. The beetles will come out and fly to the trees just as readily as from the rubbish in the plantations. A convenient form of trap-wood is made by cutting off lengths of the tops of young Scotch Firs, and setting these against standing trees, or placed in some way in which the "poles" (so to call them, for it is best to clear off the side branches) will not lie flat amongst damp grass, as the beetles prefer a more exposed position for egg-laying. These poles, of course, like all other "trap-wood," should be destroyed before the time of beetle development.

It is hardly possible to enter on all details of minutiæ of preventive treatment, but the great principle is to remove all fallen timber, or broken wood, or sickly trees before they are furnishing infestations of beetles to the trees around; or if the numbers are too great to be dealt with in this way, to do what can be done by barking.

* Note by Mr. W. McCorquodale in 'Manual of Injurious Insects,' by Editor, p. 245.

Giant Sirex; Yellow Fir Wood Wasp. *Sirex gigas*, L.
Common Steel-blue Sirex. *Sirex juvencus*, L.



SIREX GIGAS.—Female "Wood Wasp" and maggot. Jaw of maggot, with four sharp, narrow teeth; and jaw of fly, with three broader teeth—both magnified.

The damage caused by the great grubs of the large four-winged *Sirex* flies to living Fir timber of various kinds is probably much more commonly present than is generally known, for though in the past twenty years I have only in three (namely, in 1878, 1889, and 1890) had important enquiries sent regarding cause of the damage, yet specimens of these "Wood Wasps," and especially of the large black and yellow-banded kind figured above, and known as the "Giant" Sirex, are frequently sent me with a request for the name.

The dark blue Sirex, scientifically *Sirex juvencus*, is known as the "Common" Sirex, but, excepting in the year 1890, I have very rarely had observations of this species, and in the year named, curiously enough, all the observations sent of harm done were from workings of this species. The greatest damage reported was to about forty Silver Firs on a property near Whitehaven, Cumberland, of which three-fourths were said to be practically dead, "the residue in a moribund state." The trees were over seventy years of age, and the damage was estimated at a little over 1200 cubic feet of timber irretrievably ruined. In a block of damaged wood measuring fourteen inches in length by eight in diameter, thirty-three perforations were counted from which perfect insects had made their escape.

In regard to the *Sirex gigas* (figured above), in 1878 several trees some miles apart near Dalkeith, N.B., were found to be badly infested by it; one of these (a fallen Spruce Fir) was found to be "swarming" full of it. But the worst infestation I have seen myself came under my notice at Sedbury Park in West Gloucestershire. I noticed specimens on the wing there during many years whilst still resident there

during the life-time of my late father), and occasionally saw recently felled trunks from the Fir plantations thoroughly infested with Sirex, of the species *gigas* and also *juvencus*. On one occasion I saw as many as twelve to twenty specimens of *gigas* captured in a few hours as they came out of a Larch trunk lying in the home farm wood-yard, and numbers of very large ichneumon flies piercing so firmly into the infested log with their ovipositors, that they were not always able to withdraw them. Of these I cannot speak certainly as to species, for in those days I had not the requisite works or assistance for identification.

In 1890 I had observations of the *S. gigas* being observed as doing much harm in Lord Meath's woods at Kilruddery, Bray; likewise from timber at Wells, Gorey, Wexford; and specimens were also sent from near Hacketstown, Carlow, all localities on the east coast of Ireland, and so far as I am aware the presence of the insect had not been recorded as observed in Ireland previously.

In the past season I was favoured by the following note of great prevalence of grubs of the "Giant Sirex" in Larch by Mr. Wm. Forbes, of Swinton, Masham, Yorkshire. Mr. Forbes observed:—

"I am sending specimen of . . . also the larva of the Giant Sirex. This last-named insect is doing an enormous amount of damage in the Larch plantations under my charge. I am going to cut down every infested tree I find, and insist upon having the fencing tarred, and the ends of the galleries stopped up with Burgundy pitch. There is not a creosoting plant on the estate, if there had been, I should have tried creosoting the rails and posts. Every slab must be burned to destroy eggs or larvæ."—(W. F.)*

An interesting point regarding the (possibly) dangerous destructiveness of the tunnelling of Sirex grubs in timber, which has not, I believe, been often brought forward, is their occasional presence underground in coal-mines; and regarding this, on May 26th, Mr. Malcolm Burr, F.E.S., writing from Dormans Park, East Grinstead, favoured me with the following observation:—

"I enclose you a *Sirex gigas* that may interest you, received from Mr. Nath. M. Griffith, of Ruabon, a mining engineer, who tells me they find them underground in the collieries in that district. They are said to burrow holes in the timber used for prop-wood, and are supposed to come with the timber from Norway. I have taken the species near Oxford."

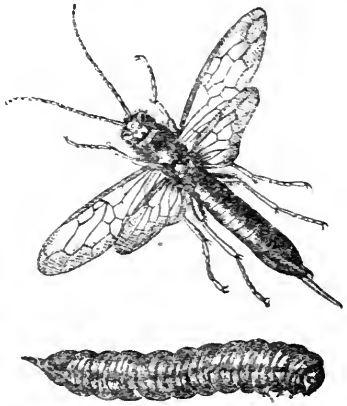
* In reply to Mr. Forbes's request for identification of the grub sent, I mentioned that it was certainly that of a Sirex; but the larvæ of the *gigas* and of the *juvencus* are so very similar in appearance, that, as the grub was not living but preserved in spirit, I could not pronounce with certainty as to species. For practical purposes, however, this was unnecessary, the habits of the two kinds being so very similar.

Of the Sirex, without distinction of species, found in this country, Mr. P. Cameron* mentions that he considers the vast majority of the specimens taken alive have been introduced with foreign timber. They are often found near wood-yards, railway stations, and *in coal-pits*. (The italics are my own.—E. A. O.)

The following note, with which I was favoured in reply to my enquiries, by Mr. John Gerrard (inspector of mines), on October 1st, from Worsley, near Manchester, bears on the matter with regard to the chief part of the infestation being considered to be imported, very similarly to the above observations:—

"Hardly a year passes without a specimen" [of Giant Sirex—E. A. O.] "coming under my notice, mostly females. Have never seen the grub, nor heard of any gallery being seen in the props. All are in or near mining timber; the timber imported from Norway."—(J. G.)

From its great size and brightly contrasting colour of its yellow and black markings the Giant Sirex is a very conspicuous insect. The female is from an inch and a third to over two inches in the spread of the wings; head black, with some yellow markings; and the body between the wings and the abdomen, excepting the first two and the last three rings (which are mostly yellow), black also. The abdomen (see figure, p. 69) ends in a long point, beneath which is, in its horny sheath, the strong ovipositor with which the insect bores through the Fir bark to deposit its eggs. The male is smaller, with the abdomen yellowish, excepting the first and last segments, which are black.



SIREX JUVENCUS.—Common Steel-blue Sirex and maggot.

The *Sirex juvencus* is a most variable insect, both in its size and colouring. The female is commonly blue-black, with brownish or

* See 'Monograph of British Phytophagous Hymenoptera,' by P. Cameron Ray Society, vol. iii. p. 134.

rusty-colour in the legs; male blue-black, abdomen with margin of the third and the whole of the four following segments red; the hinder shanks and feet dilated and compressed. The size varies from about half an inch to an inch and a third, or an inch and a half in length, and from about three-quarters of an inch to a little above two inches in the spread of the wings; and in the case of specimens sent me, the variation in size appeared to coincide with whether the conditions of the maggots during their feeding-time had been favourable or otherwise. Amongst specimens from some buried wood I had a male just under half an inch long, and a female five-eighths of an inch long, including the ovipositor.

Sirex maggots are soft and fleshy, whitish, and cylindrical, with smooth shining heads, furnished with strong square jaws, somewhat differing from each other. The three pairs of legs are short, and without marked divisions into joints; the prolegs beneath the abdomen are absent; and at the apex the abdomen is acute, ending in a sharp horny spine. The pupa resembles the perfect insect, lying soft and white, with the limbs laid along the breast and body.

The female Sirex lays her eggs in various kinds of Fir, as Scotch Fir, Silver Fir, Spruce, and Larch, and is considered to choose for this purpose trees which are past their prime, or from some cause or other are wholly or locally in not full health. It has been stated that even if a small portion is injured the Sirex will choose this spot for egg-laying, and from this centre the grubs will spread in the wood. They are also stated to lay eggs in fallen trees, or in felled trunks left lying in the woods.

The maggots bore large galleries in the solid timber, sometimes in sufficient number to riddle the trunks, and are full-grown in seven weeks, and the further change to the chrysalis takes place in the wood, but the date is considered to be uncertain,—it may take place immediately after full growth of the larva, or be delayed for an uncertain period. Consequently the imago (the perfect Sirex flies) may appear after delayed development from the most unexpected places, as from furniture or manufactured timber.

Prevention and Remedies.—Where attack is found to be prevalent in growing timber, the best treatment is to fell all that is found to be infested, and have it taken at once to the saw-pit and cut up and disposed of according to condition. Some parts would probably be free from attack, and might be used for any rough work, and other parts which were infested, and still had the insects in some stage alive within, should be burnt, or at least so treated that there was no danger of the infestation getting abroad. Felled trunks which are found to be infested should be similarly attended to, and also it should be borne

in mind that blown-down or recently felled trees are localities selected for egg-laying where Sirex are prevalent.

The attack is not often reported as injurious to a serious extent to growing timber, still the area of mischief has increased of late years, and as the insects, which make themselves perfectly at home in this country, are found to be very notably present in the vicinity of imported timber, the subject of prevention of spread to neighbouring Fir plantations may be worth attention.

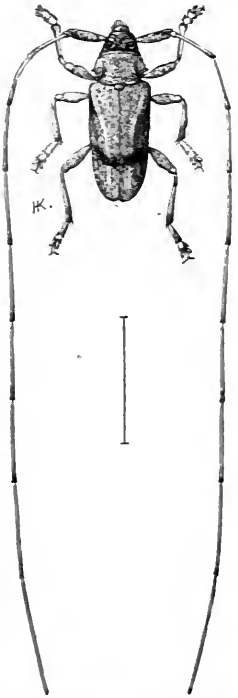
Timberman Beetle. *Astynomus ædilis*, L.; *Acanthocinus ædilis*, S.

This beetle, which is remarkable for the extraordinary length of the antennæ of the male, is found in great numbers on the Continent, but appears to be rarely met with in this country, excepting at Loch Rannoch, Perthshire, N.B., where it is recorded as being seen not uncommonly.

The only specimen I have had which could be supposed to be of truly British growth was the one from which my figure was taken, and was sent me alive from Kinnaird, Strathpeffer, Ross-shire, on August 12th, 1895.

The maggot lives under bark of Pine and Fir, and often "perforates the wood of the fallen stems," and makes large galleries in Pine stumps, forming "a nest with coarse gnawed fragments near the surface, in which it changes to pupa."

It does not appear to do mischief in this country, but, like the insects mentioned in the preceding paper, its occasional appearance in coal-mines (to the very natural perplexity of the finders) may make just the following observation sent me, with a specimen accompanying, of interest.



ASTYNOMUS ÆDILIS, slightly larger than life; line showing natural length.

On September 2nd Mr. W. Wilson, head-master of Bothal N. School, Ashington, Morpeth (Northumberland), wrote me that he would be glad of the name of a specimen enclosed, as he had not seen one before in the district. "It was caught in the coal-mine, two and a half miles from the bottom of the shaft." As the insect is of such rare occurrence here, I suggested that in all probability it had been imported in timber used for workings in the mine, which proved to be

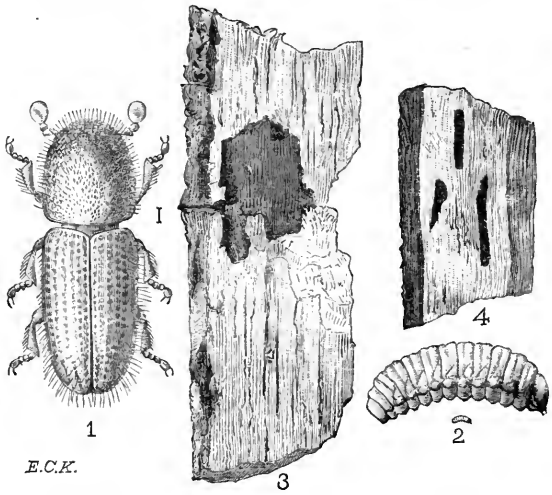
the case. Mr. Wilson wrote, on September 7th:—"Your suggestion that the beetle came from the north of Europe is quite correct, as the wood (Fir) used in the mine is brought from Norway."

As it is very unlikely that either this kind of beetle or the Sirex flies, previously mentioned, could lay eggs and set infestation on foot in timber in the condition used in mines, their presence scarcely seems of practical importance, for the number of exit-holes would be a pretty safe guide as to where so much damage had been going on as to render the wood insecure for props or mine service, but the subject is at least one of some curiosity.

The Timberman Beetle is a very pretty creature; the general colour of a brownish ash or smutty violet, and the wing-cases marked with little black spots, and with two somewhat oblique brownish bands, the front one (in the specimen figured) hardly extending beyond the edge of the wing-case, and the expanse of the antennæ as the beetle moved gently along bearing them at right angles to its body was, as near as might be, six inches.

PLUM.

Shot-borer Beetles—*Xyleborus saxeseni*, Ratz. = *Xyleborus xylographus*, Say; also *Xyleborus dispar*, Fab.



XYLEBORUS SAXESENI.—1, beetle; 2, larva—magnified, with natural length of each; 3 and 4, cell, natural size, showing broad and flat, and also narrow view.

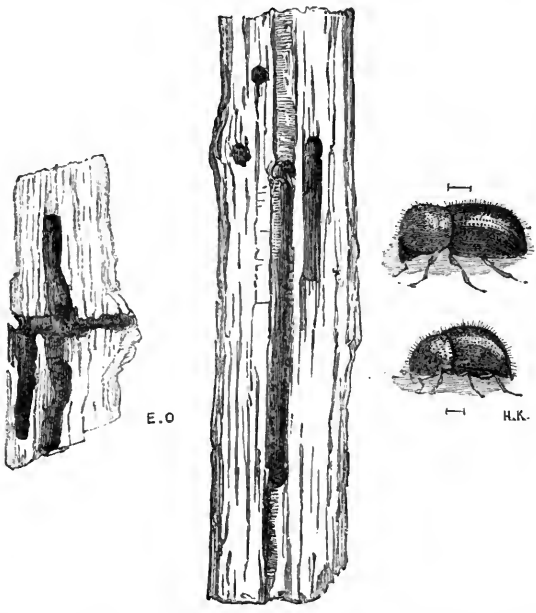
The following observations refer mainly to the much-to-be-regretted appearance of yet another kind of "Shot-borer" Beetle, namely, the *Xyleborus saxeseni*, as an infestation in wood of Plum trees. Up to the observation of its attacks in the early part of the past season, although the presence of this species in England was known of by entomologists, yet, so far as I am aware, there was no record of it having occurred here as a decided orchard pest, and naturally when the injuries were noticed they were attributed to the attacks of the *Xyleborus dispar*, which had caused much mischief at Toddington (Gloucestershire) and elsewhere a few years ago.

Excepting to skilled examination, there is much similarity in the two attacks. I know of no difference in the appearance of the shot-hole-like perforations in the bark accompanying each. The beetles themselves require knowledge and a magnifier for differentiation, and the great and striking difference of the flat cells of the *saxeseni* from the borings of the *dispar* are not noticeable without internal investigation of the attacked wood. Therefore, before entering on observations of the new pest, the *saxeseni*, I have given the few following notes of the main characteristics, together with a figure of *X. dispar* for the sake of comparison (see p. 76).

It will be only too well remembered by various leading orchard fruit-growers in the West of England that in 1889 a very small dark-brown beetle, which until that time had been considered one of our rarest species, appeared in such numbers as an infestation to Plum trees, as to cause serious mischief. From the bark of the attacked trees having the appearance of being perforated by shot-holes, the beetle is very commonly known as the "Shot-borer." Scientifically, it is the *Xyleborus dispar*, from the *disparity* in size and shape between the male and female beetles. The female is about the eighth of an inch long, narrow, and cylindrical, with the fore body (*thorax*) raised in the middle; the male is very minute, only about two-thirds of the length of the female, and broader in proportion, the thorax flatter than in the female (without the "hump").

The injury is caused by the beetles boring their tunnels through the bark of the branches or young stems of Plum trees (or other trees, as the case may be, but in this country the young Plum trees are what suffer the most), and then sometimes running their galleries so as partially to ring them, or, after boring to the central pith, to clear out an inch or more of this (see figure, p. 76), or, again, to make upright tunnels in the hard wood, or sometimes run their tunnels so as quite to girdle the branches. From the nature of the injury, the flow of the sap is checked, and the tree is often killed with a rapidity which is unaccountable, until investigation shows what has been going on in the wood.

The beetles breed in the tunnels, and in September (in this country) borings may be found so crowded with female beetles that there appears to be hardly room for one more. The males are more rarely met with; but whilst amongst fifty to sixty female "Shot-borer" Beetles which I took in September, 1889, from their borings, I only



Xyleborus dispar.—Female beetle (uppermost), male (lowest), magnified, lines showing natural length; horizontal and vertical workings in Plum stems.

found one male beetle,—in the following December I found more present, and on or about the following 10th of January I found in a piece of Plum stem of two inches and a quarter in diameter about seventeen males to six females.

Very complete observations of the infestation were sent by Mr. C. D. Wise from the Toddington Fruit-grounds in 1889, and were duly reported (see my 'Thirteenth Annual Report'), and the prompt remedial measures taken, especially that of cutting down and burning such trees as were attacked, acted so well that in the following year Mr. Wise reported that only one case of attack had been found, and since then until the present year (1897) no further reports of presence of Shot-borer Beetles have been sent to an extent calling for mention, if indeed anything at all of their presence has been noticed.

This year, however, on June 9th, Mr. C. D. Wise wrote me, from the Toddington Fruit-grounds, that they had a very severe attack of Shot-borer Beetles. He mentioned:—

"In one plantation of about eight acres, containing about one

thousand six hundred trees, we have already cut down one hundred. killed by the borer. In another field, about the same size, quite as many trees have been destroyed. We burn the trees directly we find a trace of the attack, but this does not seem to keep the enemy under, and it is difficult to know what to do."

The infestation was considered (just generally speaking) to be *X. dispar;* but, wishing to have some special examination, I begged Mr. Wise to be kind enough to let me have some specimens, to which he replied on June 19th, mentioning that he was sorry to say that he could send me (practically) any quantity of infested stems of Plum trees showing Shot-borer Beetle attack, and that he then sent me the stem of a tree, and also a portion of the branch, and that he found as many in the branches as he did in the stem.

To what extent *dispar* might be present in the trees, of course we cannot tell, but the specimens, which Mr. Wise furnished me with a most liberal supply of, showed that, though some small amount of the characteristic workings of *dispar* were to be found, the chief amount of workings were those of *Xylĕborus saxeseni*, Ratz., then very fully occupied by attack chiefly in larval condition. Of these I took the following observations.

On July 22nd, on splitting part of one of the above-mentioned pieces of Plum stem (of two and three-quarter inches in diameter) longitudinally, I found a horizontal tunnel running from the outside of about a quarter of an inch in length, on each side of which, beginning at the above distance (one-quarter inch) from the outside of the tree, a flat vertical cell was hollowed out, three-quarters of an inch long at the greatest height, and five-eighths in width. The shape of this flat chamber was somewhat squarish (see figure 3, p. 74), about two-thirds of it being above, and one-third below the mother gallery, of which some traces still remained, and which crossed the flat cell, and then was continued merely as a tunnel (a distinct gallery) for about three-eighths of an inch further, where it stopped, the extremity being filled with about half-a-dozen very young larvæ and a few eggs.

The surface of the flat chamber (as seen in the side remaining after the other side had been cut away in the course of examination) was covered for the most part with a very thin coating of wax-like material, greyish in colour, and with a somewhat sweet scent, and the surface of the wood of the chamber, wherever it was visible, was certainly not of the black colour so noticeable in connection with the workings of the *Xyleborus dispar*. It was rather of a brown colour, and moist-looking appearance.

This flat cell, or gnawed-out chamber, had only space enough between its two upright sides (see figure 4, p. 74) to accommodate the larvæ, which were for the most part apparently full-grown, and in

many cases not pure white, but tinged with colour, and with the yellow contents of a portion of the length of the food-canal showing distinctly—this circumstance and some amount of wet "frass" which was present pointing to their having been feeding on the wood; and the circumstance of there being this flat chamber gnawed out of the solid wood, on either side of the mother gallery, and containing at an estimate, several (two or three) dozen grubs, does not appear possibly to be accounted for in any other way than by it being hollowed out by the gnawings of the larvæ. Amongst these larvæ I found one advanced to the pupal stage,—milk white, with the wing-cases folded beneath it.

On July 28th, on examining the split pieces of Plum stem from Toddington, I found upon one which lay with the bark side uppermost that there were two heaps of wood-dust, one about half an inch by three-quarters broad, the other about five-eighths of an inch each way. This thrown-out wood-dust showed that there was damage going on from workings inside, and on splitting the piece of wood open, I found two parties of maggots within about two inches of each other.

These were of different ages, whitish, and legless, and distinctly lobed, the head very shining white, or, in the older specimens, with a faint yellowish tint. Whilst still alive or quite fresh the three first segments appeared to me to be somewhat inflated below, and but slightly corrugated above; the others slightly lobed below, and much corrugated longitudinally above.

In this instance the cell was a flat cavity just inside the outer wood, this chamber being about three-quarters by one-quarter of an inch in dimensions of width, and in thickness only about sufficient to accommodate the full-grown larvæ or beetles; and, as in the instance previously described, it was patched over the surface with the white fungoid formation known by writers as "ambrosia," this being sprinkled with workings of wood-dust, or "frass" of wood.

In the case of the galleries and chambers of *Xyleborus dispar*, the wood has a blackened tint, almost as if it had been burnt with a hot wire, where the fungus was removed; but in those of *saxeseni* the chambers were much lighter in tint, and it is also noted by Dr. Bernard Altum* that in his own observations he found the brood chambers of the *saxeseni* and *dryographus* un-dyed.

The smallest size of larva that I measured in the numerous collection was just over the thirty-second of an inch in length; and I found upwards of fourteen larvæ packed together in the inner part of the slit-like cavity, and perhaps a dozen or more besides. From the extreme narrowness of the chamber it was difficult to dissect out the specimens so as to be sure of amount of contents.

* 'Forst Zoologie,' III. Insecten, p. 277.

I found amongst the above larvæ three pupæ; these were readily observable, even with moderately magnifying glasses, by their bright shiny whiteness; the hinder edge of the thorax was well defined, and so was the longitudinal striation of the wing-cases.

Notices of much injury from "Shot-borer" to Plum were also sent from near Evesham. A proprietor at Longdon Hill, in that neighbourhood, mentioned that his plantation of six years' growth, and ten or eleven acres in extent, and very promising, had been badly affected, and quite ten per cent. of the trees had succumbed.

In other places in the neighbourhood losses also were sustained, and a wish was expressed for certain information as to the cause of the mischief; but so far as I saw from specimens sent me, although there appeared to be a small quantity of the *Xyleborus dispar* (which did such great harm a few years ago) present, the greater part of the damage then in progress was caused by the *X. saxeseni*.

As this species, although not new in England, is only recently observed (as above) with us as seriously destructive to Plum wood, I took the opportunity of consulting Dr. James Fletcher, the Entomologist of the Experimental Farms of the Department of Agriculture, Ottawa, Ontario, Canada, during his stay in England, on the subject, and he carried a sample with him on his return home, regarding which he was good enough to write, on October 5th, as follows:—

"I have delayed writing to you until I heard from our authority on *Scolytidæ*, Prof. Hopkins, of Morgantown, West Virginia. He says this is a very interesting species, and has quite a history. It seems that Say named it *X. xylographus* in 1825, and a short time after Ratzburg named the same thing *X. saxeseni*, and although this fact has been referred to in publications by Eichhoff, Schwarz, and Packard, our European brethren persist in calling it *saxeseni*. It is an exceedingly common species here in West Virginia, occurring in the wood of old Apple trees. I have compared your English specimens with my large series of specimens collected here, and those from France and Germany, and it appears they must all belong to the same species."—(J. F.)

The above communication is, I think, of much interest as identifying our infestation by comparison of specimens as similar to that of the United States of America and Europe, and also as giving the reason for the continuance of the difference in specific name by the American and European entomologists.

The following extracts, taken from the notes published during the present year by Mr. H. G. Hubbard, one of the "investigators" of the United States Board of Agriculture,* agree excellently with what was

* See "Ambrosia Beetles of the United States," by H. G. Hubbard, in 'Some Miscellaneous Results of Work of the Division of Entomology,' United States Department of Agriculture, Washington, 1897, p. 24.

observable in the specimens sent me from Toddington of the *Xyleborus xylographus*, Say = *saxeseni*, Ratz. :—

"The young in this species are assembled in a brood chamber. . . . It is constructed at the end of a gallery which penetrates deeply into the heart, or remains in the sapwood, according to the amount of moisture in the tree-trunk, . . . and stands vertically on edge parallel with the grain of the wood. The space between the walls is not much greater than the thickness of the bodies of the adult beetles." [See my own observations preceding on the narrowness of the chamber from side to side, and also as to the larvæ working away the wood, p. 78.—E. A. O.] "The larvæ aid in extending the brood chamber. They swallow the wood which they remove with their jaws, and in passing through their bodies it becomes stained a mustard yellow colour. Great quantities of this excrement are ejected from the openings of the colony, but a portion is retained, and plastered upon the walls, where it serves as a bed upon which there springs up a new crop of the food fungus."

The nature of this fungus is of great interest, and has been the subject of much discussion from the time of Canon Schmidberger, who described this substance (of which the nature was not then known) under the fanciful name of ambrosia,* up to the elaborate observations given, with illustrations accompanying, by Mr. H. G. Hubbard in his paper on the "Ambrosia Beetles," lately published, and referred to in note at preceding page.

At p. 9 Mr. Hubbard states that "the term Ambrosia Beetles is used as a convenient one to distinguish from the true bark-borers and bark-eaters" [the Elm-bark Beetle, *Scolytus destructor*, for example,—E. A. O.] "the timber-boring *Scolytidæ*, which push their galleries deeply into the wood, and which feed upon a substance called ambrosia. . . . Their food consists not of wood, but of certain minute and juicy fungi propagated on the walls of their galleries." These fungi, it is stated, are of different kinds, each species of "Ambrosia Beetles" (or, if not strictly each species, only those most closely allied) feeding on one kind, and one only of ambrosia fungus. Some of these fungi are like a pile of beads in appearance, but the *Xyleborus saxeseni* (= *xylographus*) fungus is of upright stems set close together, with a swollen cell at the end of each, and not unlike in general appearance, when enormously magnified, to a great number of short, very thick-stemmed pins, with round heads, set very closely together.†

Regarding the habits of *X. xylographus*, Mr. Hubbard mentions that it breeds only in dying trees, and generally only in trunks of large

* 'Naturgeschichte der Schadlichen Insecten,' von Vincent Kollar, Wien, 1837, p. 264; and English translation, called 'Treatise on Insects,' London, 1840, p. 257.

† For figure, see p. 25 of Mr. Hubbard's paper, previously referred to.

size. It appears to be partial to rather hard woods, like Oak, Hickory, Beech, and Maple, and is found wherever these trees grow, both in this country and in Europe. It does much injury to timber, and in cut lumber the broad flat chambers produce defects which cannot be remedied by plugging."

In regard to distribution, it is mentioned by Herr Eichhoff* that "*saxeseni* is not only distributed over the greatest part of Europe, but is also found in the Canary Islands, in North America, and probably also in Japan. Amongst the bark beetles, it is a remarkably general feeder, for it lives and breeds not only in the wood of the most different kinds of leafy trees, as Oak, Beech, Birch, Maple, Lime, Poplar, and orchard trees, but also in various of the needle-leaved trees" [as Pine and Fir].

In regard to dates of appearance, Herr Eichhoff notes that females of the first brood swarmed in his wood stores at the end of May and June. Also that Noerdlinger found in August pupæ already yellow-coloured, which developed a few days after; and Schreiner found on one occasion, on September 12th, only larvæ; on others, at the end of November and beginning of December, there were with the still living mother beetles what were certainly young beetles, besides full-grown and also still quite young larvæ. He (himself) found during winter young beetles, with still half-grown and full-grown larvæ. From this, Herr Eichhoff points out there can be no doubt that the beetles developed in August, and later again fly and breed, and from these proceed the hybernating beetles and larvæ.

The year's circle of propagation is thus completed from the beetles seen in great numbers appearing at the end of May, through a second generation to the hybernating brood supplying the spring or early summer attack.

We have not yet traced the infestation all the year round here, but presumably it is the same. In the chambers of *X. saxeseni* sent me on July 19th, I found eggs, larvæ, and one pupa still milk-white; and a little later on, more pupæ. Early in September I found six or eight beetles in my rearing-box which had come out of the Plum wood, and which proved, on submitting them to Mr. O. E. Janson for certain identification, to be females of *X. saxeseni*, with the exception of one single specimen of the male, which sex appears to be rare in this species as well as with *X. dispar*, as Herr Eichhoff notes, in a summary of numbers counted, a proportion of only fifteen male beetles to three hundred and seventy-four females. The winter condition I had not the opportunity of investigating.

This species is somewhat slender and elongate in shape; the

* 'Die Europäischen Borkenkäfer,' von W. Eichhoff, Kaiserl. Oberforster in Mulhausen, i. Elsass. Berlin, 1881, p. 280.

females pitchy black, with a small amount of grey hairs, and rusty yellow antennæ and legs; the males shorter, and of a paler brownish colour, and with longer hairs. The female is about the eighth of an inch, the male somewhat less in length. They may be readily distinguished from *X. dispar* (the only species which at present there may be occasion to distinguish them from here) by the female of *dispar* having the thorax (or fore body) large in proportion, and raised in the middle into a kind of hump, while the male, which is only two-thirds of the length of the female in this species, is remarkable for being much wider in proportion, and flat on the back. From all other species of *Xyleborus* it is considered that *saxeseni=xylographus* may be distinguished "by the very regular rows of small but sharp teeth upon the declivity of the elytra." (See 'Ambrosia Beetles,' referred to previously.)

In the course of correspondence on the "Shot-borer" infestation, I was favoured by Mr. C. D. Wise with an observation of a coincident appearance of Mites (*Acari*) in such vast numbers on the stems of Plum trees infested by the "Shot-borer" that, on working up the subject, there seems to be good ground for hoping that these may be an important help in keeping both species of *Xylebori* in check.

On July 30th Mr. Wise wrote that there were "hundreds, even thousands" [of the creatures which at first were taken for little beetles], "crawling about all over the stems of the trees, and these have spread to the trees adjoining." A few days later Mr. Wise mentioned that they were to be found in hundreds on the trees which were dying from attacks of the "Shot-borer"; and successive letters showed the vast numbers to which the infestation was increasing, as on August 7th "they are all over the stems of the trees in all directions"; and on the 12th, "the stems of our trees are covered with millions of them."

As it was exceedingly desirable to have an authoritative opinion what the hordes of creatures were doing, I suggested to Mr. Wise that we might venture to request Mr. Albert D. Michael (of Cadogan Mansions, Sloane Square, London, S.W.) to assist us by identification, and on August 23rd he was good enough to write as follows:—

"The creatures sent are *Acari*, as Miss Ormerod correctly says; their name is *Oribata lapidaria*. They are very abundant, and probably the fine season has caused them to increase to an unusual degree. I do not think, however, that you need be alarmed at their presence; they are vegetable feeders, but I never heard of their doing any practical harm to the trees or plants which they are found on; they feed chiefly on lichens and minute fungi, and will, I should think, help to keep your trees clean rather than injure them. I observe that the scraps of bark which you sent me are covered with lichens (micro-

scopic), &c., just what these *Acari* like. If it were my case, I should let them alone; but if you wish to destroy them, it will be rather difficult to do so while they are in the adult stage; chemicals are useless then, as they do not penetrate the hard shell; boiling water would do it at once if it could be conveniently applied without injuring the trees, but I believe that there is often a practical difficulty about this. If it cannot be done, a sticky material, such as soap, tar, &c., would catch large numbers, but not all.

"When the creatures are in an immature condition, rather earlier in the year (probably about June), the ordinary paraffin and soap solutions (strong) would probably kill them if applied three or four times at intervals of ten days or a fortnight, so as to catch fresh batches as they hatch from the eggs (which are impervious to chemicals).

"If you wish to know the immature stage by sight, you will find a coloured illustration of it in my 'British *Oribatidæ*,' Ray Society, plate v. figure 2. It is very different from the adult; but, as I have said before, my own impression is that the best thing you can do is to let these creatures alone."—(A. D. M.)

The family of the *Oribatidæ*, which are often known as "Beetle-mites," because, in the adult stage, they have a hard skin (chitinous exo-skeleton) like beetles, are very small somewhat globular *Acari*, often black or brown in colour, and have eight legs. In their first condition (that is, after hatching from the egg) they are soft, and have only six legs. The *O. lapidaria* (of Lucas), mentioned above, is only about a third of a millimètre in length,* and dark brown, and usually, though not quite always, also shining in the adult state; in the preceding condition it is more of a diamond-shaped form, and "orange red varying to dark pink" in colour; in the first stage most of the *Oribatidæ* have little colour. (See Mr. Michael's work, previously quoted.)

The above remarks on this fungus-eating "Mite" are submitted in view of the possibility of it being in some degree a natural protector against increase of the "Shot-borer" or "Ambrosia" Beetles, by robbing them, *for its own support*, of the "ambrosia fungus," on which they mainly feed. We cannot tell how this may be without further observations verified by an expert. Unfortunately I have not sufficient knowledge of these "Mites" in their early stages to make my identification trustworthy; but it may prove of some interest to mention that, about December 11th, on examining my few remaining specimens of *saxeseni*-infested Plum wood, I found a number of minute white "Mites" straying about the "ambrosia" patched surface of one of the *saxeseni* brood-chambers; and on the 14th I found them still there or

* A millimètre is the twenty-fifth part of an inch.

in the entrance gallery, one of them being advanced then to a pink colour, and a shape resembling the figure of the "nymph" state of *O. lapidaria* given in plate v. of Mr. Michael's '*Oribatidæ*,' vol. i., previously referred to.

Prevention and Remedies.—One of the most plainly serviceable of these is cutting down and burning the infested portions of all trees—Plum, Apple, or otherwise—found to be undergoing attack, taking the shot-hole-like perforations in the bark and the wood dust thrown out as a guide, to some degree, for investigation of the nature of the mischief going forward within. Presumably, also, the use of what is called "trap-wood" would answer as well for attracting this species (the *saxeseni*) as the *dispar*. These traps may be arranged by setting poles of any kind of wood that the beetles naturally frequent, with one end in the ground so as to keep them fresh for a while, and examining them every three or four weeks, and destroying them if found to be infested. The season for "trapping" is March to August or September, or later still in the year, if examination shows infestation continuing. Felled trees also may be centres of spread of infestation if not looked to, and also stores or timber-yards near orchards may need attention as to infested wood stacked there.

The mixture known in Canada as the "Saunders' wash," and referred to at p. 47, preceding, could not fail to be of use. This is soft-soap reduced to the consistence of a thick paint by the addition of a strong solution of washing soda in water; "this, if applied to the bark of the tree during during the morning of a warm day, will dry in a few hours, and form a tenacious coating not easily dissolved by rain."

Another method of dealing with attacks of *Xylebori*, or "Shot-borers," is plugging up their entrance-holes, in regard to effect of which it is noted at p. 11 of Mr. Hubbard's paper, previously quoted, that by closing the outlets of the galleries through the bark, or by spraying into them kerosine or some other noxious liquid, the contained beetles are so discomposed that they run in all directions, and by trampling on and crushing the young larvæ and eggs, and breaking down the exceedingly delicate fungoid growth, a state of things is induced in which the living insects are destroyed.

In the same paper, at p. 13, under the head of "Remedies," are the following notes, which I give at length, as the most recent observations on the subject:—

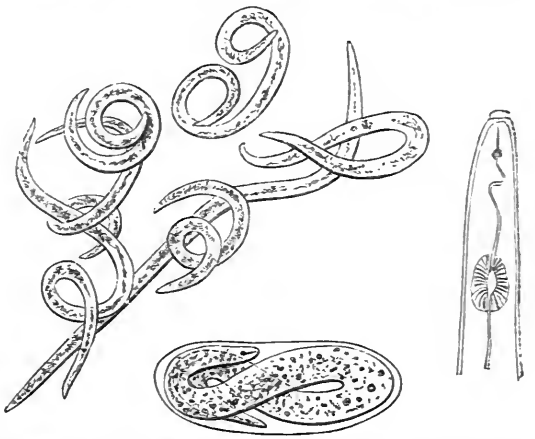
"From what has been said of the nature of the food of these beetles, it is evident that any method by which the entrances to their galleries in the bark can be closed will effectually put an end to the progress of their colonies. Perhaps the best means of accomplishing

this is by coating the trunks with dendroline or raupenleim. A light brushing or spraying of the bark with creosote or kerosine will sometimes accomplish the same result, especially at the beginning of an attack. But this cannot be depended upon to permanently protect the trees.

"Valuable fruit trees which have suffered injury from fire or frost cannot always be protected from attacks of the borers by coating the bark, because of the risk of injury to the buds, which must be allowed to grow upon the trunks. In such cases if borers enter the wood their holes must be plugged. An excellent method is to insert an iron wire as far as it will go, cut it off, and leave the piece in the hole. The inhabitants of colonies thus imprisoned are unable to extend their borings, and inevitably perish."—(H. G. H.)

STEM EELWORMS.

"Tulip-root" in Oats, **"Stem-sickness"** in Clover, caused by **Stem Eelworms,** *Tylenchus devastatrix*, Kuhn.



TYLENCHUS DEVASTATRIX, Stem Eelworms.—Anterior portion of female showing mouth-spear; and embryo in egg; all greatly magnified: anterior portion magnified 440 times. From figures by Dr. J. Ritzema Bos.

During the past season "Tulip-root" appears to have been more than usually prevalent in the Oat crop. Very characteristic specimens of this peculiar malformation, so called from the base of the Eelworm-infested stem being swelled into a bulb-like or "tulip-rooted" form (often with a number of short, swelled, and contorted shoots surrounding

the base of the bulb), were sent me from widely separated localities, from Kent up to Pincaitland, East Lothian, N.B.

This attack, which there has been occasion to refer to frequently since it was first brought forward in 1886,* is caused by presence of Eelworms, so minute that, being only about the twenty-fourth of an inch in length, they are invisible to the naked eye, but with the help of a magnifier they are to be found in swarms in egg, larval, and male and female condition in the deformed parts of the infested plants. In these they form for the most part, as, for instance, in "Tulip-root," Clover "Stem-sickness," and "Onion-sickness," swelled growths, by which the attention of those acquainted with the different forms of development may be at once directed to the mischief that is going forward, and unless the attack has been allowed to become too much advanced it may be mitigated, or, in the case of Clover Stem-sickness, successfully got rid of by various applications (see p. 94).

The deformed growth is an external guide, and internally the attacked plants of Oats or Clover will often be found, where the attack is somewhat advanced, to be more or less hollow, with the surface of the cavity spongy, and gradually, with increase of the disease, the surface becoming yellowish or brownish with decay, and in this I have found great establishment of the Stem Eelworms. The Eelworms are also to be found in the contorted shoots of "Tulip-root" (see figure, p. 88), and I have found them at various ages in very young Oat plants sent to me in November, but amongst these I did not find more than a few that were apparently fully grown, and the "Tulip-root" growth of the Oat plant was not then developed.

For figures of worms and egg, see p. 85.

It may just possibly be of some practical interest (in regard to being on the alert to watch for appearance of first signs of "Tulip-root") to draw attention to the generally late sowing time which was necessitated in the past season by the adverse weather of the early part of 1897. "Not for years had the arrears of tillage work been so great at the middle of April, heavy lands in most districts and light lands in not a few being more or less waterlogged. . . . Teams were kept hard at work, completing in the latter half of April tillages that ought normally to have been finished a month earlier." †

In repression of Eelworm attack, that is, both in destroying the pests and restoring healthy conditions, it has been found that such circumstances as give a sound vigorous growth are very important; therefore it may be found that the circumstances which were unfavourable to the Oat plant in its early stage had to do with the prevalence of Tulip-root. But however this may be, more applications

* See my 'Tenth Annual Report on Injurious Insects,' pp. 35–47.

† See "Agriculture in 1897," 'The Times,' Dec. 27th, 1897, p. 8, column 1.

were made to me than commonly occur as to presence of the disease; and it is rather curious that though the Tulip-root form was very markedly present, I had not any samples sent me of the other form known as "Segging," from the widened form of the leaves with waved edges resembling those of Sedges.

A few other points of interest occurred in connection with some of the samples sent.

The following observation, which was sent me on May 5th, in the course of some communication as to Tulip-root in Oats, by Mr. F. R. Armytage, from Windsor House, Shrewsbury, is of practical interest relatively to the power of these Eelworms of bearing "desiccation," that is, of being thoroughly dried, and remaining in this state for some weeks without any injury beyond loss of power of motion for the time being. After some remarks on specimens of Tulip-rooted Oats previously sent to him, Mr. Armytage observed :—

"It may interest you to know that after placing the worms on a slide with a drop of water, I put the slide away for quite six weeks, at the end of which period, although the water must have evaporated in twenty-four hours, on again applying water to the edge of the covering glass with a pipette, the worms were as lively as ever."

The extraordinary tenacity of life possessed by the *Tylenchi* (as well as by members of a few other genera of Eelworms), which enables them to remain for lengthened periods of desiccation as if dead, yet still retaining the power of resuming the vital functions on the restoration of requisite moist conditions, was made the subject of investigation many years ago—so far back as 1744—especially with regard to the *Tylenchus tritici*, Bastian, which causes the diseased gall-like growths known as "Ear-Cockles," or "Purples," or "False Ergot," in grains of Wheat, and sometimes also, though more rarely, in those of Oats and Rye.*

But in regard to precise length of time to which it has been proved that this drying process may be continued, and its action on the "Stem Eelworm," the *Tylenchus devastatrix*, in its different stages of life, full information will be found in the report by Dr. J. Ritzema Bos of his own more recent observations.† From these it is shown that eggs of this species not yet arrived at a moderately advanced stage of development,‡ might safely be dried for a period of two months, but if allowed to remain dry for a year, only about a third recovered on

* *Vibrio* (Muller), *Anguillula* (Ehrenberg), *Rhabditis* (Dujardin). See "Mon. on the Anguillulidæ." by H. Charlton Bastian, 'Trans. Linn. Soc.' vol. xxv. pp. 87, 88.

† See 'L'Anguillule de la Tige' (*Tylenchus devastatrix*, Kuhn), par Dr. J. Ritzema Bos. I. Haarlem, 1888. Pp. 86–92.

‡ "Segmentation of the protoplasm" (J. R. B.).

being moistened; the other two-thirds were dead. Eggs, however, of which the contents ("protoplasm") were divided into two, four, eight, or sixteen segments, could not bear desiccation for even six days. After moistening they did not continue to develop. Eggs which had advanced to containing the Eelworm in embryo condition had the power of remaining in the *state* of suspended animation for six months (possibly still longer) without losing the power of re-animation, on application of moisture (p. 88 of work quoted).

The power of the larvæ to regain conditions of active life after desiccation was found to be very great, and the result of the series of experiments made by Dr. Ritzema Bos (see pp. 89–92, *loc. cit.*) showed that after suspended animation during a period of two and a half years they returned to their normal state.

The adult Tylenchi (that is, those in which differences of sex were observable) could not support life under desiccation.

These observations, of which I only extract a small part, are of very practical bearing, as showing that such of the Eelworms or their eggs as are in a stage of life to bear drying may remain safely (to themselves) in straw, or in the surface of the ground, in a dormant condition, or state of "latent life," without needing food, so long as the surrounding circumstances are dry enough for the purpose, and with recurrence of moisture regain their active vitality, and powers of crop injury.

Applications regarding Tulip-root, beginning on May 6th and continuing at intervals during the summer, from widely separated localities extending as far north as Pincaitland, in East Lothian, showed for the most part very marked presence of the characteristic malformation at the base of the stem, and likewise the bad injury caused by the attack.

Tulip-rooted Oat plant.

On June 14th specimens of Oat plants were sent me by Mr. M. A. Streatfield from Chested, Chiddingstone, Edenbridge, Kent, with remarkably characteristic examples of the form of "Tulip-root," in which swelled and distorted side growths, twisting in all directions, are formed at the base of the main shoot, excellently resembling the accompanying figure. The plants sent were about nine inches high. Enquiry was sent accompanying as to the nature of the attack, and whether likely to injure Clover seeds sown with the Oats. "The Oats were got in rather badly, *with a shallow seed-bed*, and were manured with guano. They came up very well, and promised to be a good crop till a few weeks ago; but I now find large patches of plants like enclosed" (M. A. S.). In this case

the preceding crop is not mentioned, but as infestation of Eelworms when remaining in the land, is most especially near the surface, it suggests that the shallow seed-bed mentioned may have had something to do with the attack.

On June 19th a sample of growing Oats from a crop then dying away from something going wrong round the roots was sent me for examination from the Estate Office, Calthorpe, near Rugby. The plants were in a very bad state; some, if not all, had the outer leaves dying and brown, and the plants themselves were still small, at a general estimate only about six inches high.

On July 18th specimen plants of Black Oats were forwarded to me by Mr. C. Ireland Blyth, from Plestowes, Barford, showing remarkably bad attack of Tulip-root, with great quantity of distorted shoots at the base of the stem (see preceding figure). In this case scarcely any of the leaves were more than twelve inches in length. The field from which the plants were taken was mentioned as being very much damaged by some attack "which resolves itself into making the plant as per enclosed."

On Aug. 2nd an application was sent me by favour of Messrs. Webb and Sons, Stourbridge, regarding condition of a sample of Black Tartarian Oats, of which the sender had mentioned that "the crop came on all right until recently, when some disease attacked it, with the result shown by specimen plant." This was the only sample sent me in which the nature of the infestation was only drawn attention to by the swelled or Tulip-bulb-like enlargement of the base of the stems (from which the attack takes its name), unaccompanied by the growth of little spindling shoots, pale in colour, and bent in all directions of their inch or two in length, which often surround the lowest part of the swelled base of the Oat stem.

Later on, on Dec. 20th, I was favoured by the following note of a summer attack, once again to Black Tartarian Oats, being sent me by Mr. T. Carrington Smith, from Admaston, Rugeley. After referring to some recent observations of my own on Tulip-root in Oats, Mr. Carrington Smith observed:—

"You say very truly that this disease has been 'more than ordinarily prevalent.'

"In seven acres of Oats, after Swedes, on land very clean and in excellent condition, the disease destroyed more than half my crop in a very erratic and patchy manner. In the ordinary course of treatment both mineral superphosphate, 3 cwt., and nitrate of soda, 1 cwt., had been applied before the disease was suspected. And in the ordinary course Clover seeds of alternate husbandry had been sown on land through which an apparently good plant of Oats was springing.

"What puzzles me is the fact that the seeds have all along been

splendidly strong, especially the Red Clover. They have given during several months of the autumn a large amount of sheep keep, and they are now attracting large flights of Wood Pigeons, which, as you know, feed greedily on the leaf of Red Clover.

"Now, why is the Clover apparently free from disease on ground where the Oat crop was greatly damaged from Tulip-root? By the way, the Oats were Black Tartarians, from which I expected a very big crop. About thirty years ago I lost a crop of Oats in a similar way, but not on the same ground."—(T. C. S.)

I certainly without more information of previous details cannot say with certainty why the Eelworm should leave the Clover uninfested; but there are two points, either of which might bear on the matter. One is that the Clover was in such remarkably hearty and healthy growth. This is in itself a great help against injury from Eelworm infestation. The other lies in the circumstance that although Eelworms from one kind of crop subject to their infestation can pass, as we constantly see, to another crop similarly susceptible, yet it is matter of recorded observation that where they (the *Tylenchus devastatrix*) have lived for some generations in one kind of plant, that if possible they prefer continuing their infestation to that kind to attacking plants of a different nature.

Some special instances of this in the case of *non*-infestation of Clover, in connection with infested Rye, are given by Dr. Ritzema Bos, in his work previously quoted, p. 73:—"In different parts of Limbourg, where Clover is rarely or never cultivated, the *Tylenchus devastatrix* does not pass into this plant, or at least it is not attacked by the sickness even when it is sown on infested ground." Similar observation is noted to have been made in some other districts, where Rye has been grown for years on infested fields, but Clover rarely or never. "But in countries where Clover is much more cultivated, the plant is not exempt from the attacks of this dangerous nematode" (the Stem Eelworm, E. A. O.).

In this country we are in the latter situation; Clover and Oats are constantly infesting each other to and fro, and the matter is one of practical interest, although in the case of Mr. Carrington Smith's crop I would not without details say what was the cause of the failure.

The Clover-sickness above referred to, which is due to presence of Stem Eelworms, is easily distinguishable from all other kinds of Clover disease, whether caused by unsuitableness of soil, insufficient alternation of crops, mould or fungoid attacks, maggots of the Clover and Pea Weevil at the roots, or other injurious circumstances, by the *definitely deformed growths*.

In the case of Clover "stem-sickness" in the early part of the year, the circumstance of the stalks and branches being shorter and

thicker than in healthy growth, and the buds also themselves being much thicker in shape, is characteristic of attack, and probably various of the stalks and branches will be found dying or decaying; and the Stem Eelworms may be found both in young and mature state in the plants, and very numerously in the buds.

During summer the characteristic malformations are very observable, and I have had specimens sent me in July in which some of the stems with flowering heads were still to be found, but also there were a large number of short barren shoots about an inch long, oval in shape, and with the distorted growth of leaves then merely forming an imbricated or "tile-like" exterior. These shoots were placed closely together, apparently from the growth of each shoot having been stopped.

They varied in number; sometimes as many as five grew on an inch length of stem, one at the extremity and two at each side below, so as to form together a flat fan-like mass. I did not find that they grew round the central stem. They were not all similar in form of diseased growth, but were commonly irregularly and oval or somewhat bulb-shaped; but sometimes they were much prolonged, so as to resemble what is known as a "duck-necked" Onion in shape; and sometimes the lower part of the flowering stem was enlarged for an inch or two at the base. In various of these shoots I found the Eelworms present up to numbers which might be described as "swarming" in the palish brown powdery, or rather granular, matter in the hollow near the base, or other parts of the perishing shoots.

But it is usually the spring or rather the winter condition, of which samples are sent me for identification; and I believe that if the characteristic appearance of these was more generally known, so that remedial applications could be applied in time, a great deal of loss might be avoided.

On Jan. 13th in the past year I received samples from Mr. J. Fairweather, of Havestock, Kelvedon Common, Brentwood, of Clover which had been sown with Oats, and was stated to have grown away splendidly after the Oats were harvested two months before, but then was in the usual condition in which the winter specimens come to my hands. The part of the plant above ground showed the peculiar growths characteristic, as above mentioned, of Clover Eelworm sickness, and also much decay; but still there was a little attempt to establish new growth still going on, showing that if the attack had been taken in time the crop might very likely have been saved.

I am not aware that a good figure has been placed before the public of the malformation to Clover shoots caused by this disease, and if further on in the season, when characteristic specimens are procurable, any of my correspondents would be kind enough to favour

me with a few little pieces showing the distorted buds closely placed on the stems as mentioned above, I should be very glad of the opportunity of having a good figure taken.

Prevention and Remedies.—Details of these, with the reasons for the adoption of the preventive measures, have already been given in my Annual Reports referred to below,*—regarding Tulip-root and Clover Stem-sickness, most especially in the three first-named, Field Bean attack in the Fourteenth, and Onion "Eelworm-sickness," chiefly, in that of last year. It is therefore not desirable to go over the details again, but just a general note of points to be considered may be useful.

With regard to spread of infestation.—A large proportion of the Eelworms leave the plants when dying and *drying* (as in Oats, for instance), and go into the surface soil, but some remain in the plants. To get rid of those in the land, common ploughing or digging is of very little service, it only disperses them about. But ploughing with skim-coulter attached, or trenching (true trenching, not mere double digging), will bury them well away. Infested stubble should be dealt with on the same principles. It is no use just lightly ploughing it in, at least it should be collected and burnt, and if circumstances allow of it being burnt standing, it would be a most excellent treatment. This would not only destroy the infestation within the stubble, but would also get rid of many kinds of crop vermin in and on the surface of the land to a very beneficial extent. As before mentioned, in firing stubble a band should be burnt first round the edges of the field, or at least at the edge *towards which the wind drives*, so that the fire may be kept with certainty under control whilst there is still only a very narrow band burning, and this burnt-off surface will quite check the advance of the fire presently, and so prevent indiscriminate spread to the great damage of hedges, or possibly even more important losses.

Returning to infested stubble or fodder: if what is carried from the field becomes mixed (as in litter, for instance) with manure, the Eelworms will in all probability be carried out again to re-infest the fields. It should also be remembered that they may be carried to an amount to do mischief in such surface earth of the infested field as may cling to the boots of workmen or agricultural implements or garden tools. In this manner patches of infestation, such as those mentioned at p. 89, are very liable to be spread.

The principle of such rotation of crops as will not allow one of a nature that is very liable to infestation immediately to succeed another needs no comment. With us, Oats and Clover are the field crops most

* Tenth, Eleventh, Thirteenth, Fourteenth, and Twentieth Annual Reports on Injurious Insects, by Editor.

liable to infestation, but Field Beans are also subject to the attack causing a stunted and deformed growth, such as that shown in the

Field Bean plant infested by *Tylenchus devastatrix*. Natural length, including curve of stem, about ten inches.

accompanying figure, taken by myself of one of a bundle of plants sent me for examination. Of these, the specimen figured above was only

about ten inches in length; another only four; whilst a Bean plant sent accompanying showing the natural length was over three feet and a half.

Onions are also (see my 'Twentieth Annual Report' for details and figures) subject to attack, and lists of other crops which are to some degree liable to infestation, as well as weeds and grasses which serve as food-plants to keep the Eelworms alive in absence of the field crops which they will (if circumstances permit) presently transfer themselves to, will be found in my papers previously referred to, as well as detailed observations regarding applications which have proved trustworthily serviceable for use to ground before sowing, or, *remedially*, to check attack and push on growth.

The following notes are just given merely shortly from the abstract published in my leaflet on Stem Eelworms, of which I should be happy to send copies free to any applicant; and I should like particularly to draw attention to the circumstance that, whilst marked success has attended use of sulphate of potash and some other sulphates named, nitrate of soda has failed, so far as report to myself shows, in producing satisfactory results.

Special applications, which have been found most serviceable for Clover and Oats, whether as preventives, as manure in the preparation of the land, or as dressings to bring a crop over attack, are sulphate of potash alone, as a mixture with sulphate of ammonia, or both of these with phosphates.

Sulphate of potash at the rate of 1 cwt. per acre has had a good effect in stopping the disease and bringing a good crop;—also at the rate of about ½ cwt. per acre it has done well.

As a manurial application, a mixture of about two parts sulphate of potash, three parts sulphate of ammonia, and four parts of phosphates, brought remarkably healthy plants, with few exceptions.

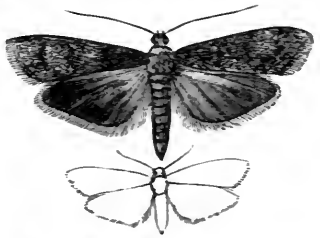
A recipe found to answer well in case of attack in "Tulip-rooted Oats" or "Stem-sick Clover" is—sulphate of ammonia four parts, sulphate of potash one part, and steamed bones two parts; this at the rate of 1½ cwt. per acre, followed up by a dressing of 2 cwt. per acre of sulphate of ammonia.

The following note of experiment in treatment of Clover-sickness at Rothamsted, which I was kindly permitted to use, showed entirely satisfactory results:—"A mixture of sulphate of potash 3 cwt., and sulphate of ammonia 1 cwt. per acre, was applied on April 3rd." The disease ceased, and the Clover made a very vigorous growth, which was continued markedly in the second crop. Sulphate of iron at the rate of 2 cwt. also answered very well both for stopping the disease and giving good growth; at the rate of 1 cwt. the sulphate of iron was not so serviceable.

All measures, whether of treatment of the ground or of liberal and rich manuring, of a nature suited to drive on hearty growth are of use in supporting infested plants if of material suited to its special nature, but nitrate of soda (so far as reports to myself go) has proved nearly or wholly valueless as an antidote to Eelworm-sickness.

STORED GRAIN AND FLOUR.

Mediterranean Flour or **Mill Moth.** *Ephestia kühniella*, Zeller.
Granary Weevil. *Calandra* (*Sitophilus*) *granaria*, Linn. **Rice Weevil.** *C.* (*Sitophilus*) *oryzæ*, Linn.
Hay Mite. *Tyroglyphus longior*, Gervais.



EPHESTIA KÜHNIELLA.—Flour Moth, magnified; outline showing natural size.

The infestations above named have all been entered on before in due course, but as some additional points of serviceable information have accumulated I give the observations under the collective heading of "Stored Grain and Flour," with a repetition of just sufficient of the life-histories of the insects to make the notes intelligible without referring back.

In regard to the destructive flour pest known with us as the "Mediterranean Mill Moth," the researches of various enquirers, both European and American, during the last few years have shown that the existence of this infestation has been known of in different countries for a much longer period than at the first observation of it as an important pest—in the year 1877—was supposed to be the case. Also the distribution of its presence in various countries has proved to be more general; and also, and more recently, it has been recorded from European and American observations that, under pressure of circumstances, the larvæ or caterpillars of this *Ephestia kühniella* moth by no means restrict themselves to consumption of Wheat flour, which is their special food, but will extend it to unbroken grain, and to flour in manufactured and baked condition.

The first observation of this infestation as a serious mill trouble was for some time considered to have been made in 1877, when the caterpillars were found to be very troublesome in the bolting-cloths during the grinding of a quantity of American flour, and moths from these were submitted by Dr. Kühn (Director of the Agricultural Institute of the University of Halle, Germany) to Prof. C. P. Zeller, of Grünhof,* by whom they were found to be a species of *Ephestia* not previously described, and were specifically named by him after their observer—Dr. Kühn—as *kühniella*.

The first recorded observation of the appearance of the attack in this country was, so far as I am aware, in 1887, when moths which had been bred from "Rice-cones" were submitted to Mr. Barrett, and identified by him as a species new in this country, namely, the *Ephestia kühniella* of Zeller.† In the course of the same year "a colony of this scourge of the Mediterranean ports" was discovered by Mr. Sidney J. Klein in some large warehouses in the East End of London, where there were over a thousand tons of flour stored in close proximity, and "the attack spread with great rapidity until one entire warehouse was literally smothered with larvæ, and several hundred pounds worth of damage was done." ‡

Some observations on the attack and some which appeared to refer to it were sent to myself, but it was not until September 15th, 1888, that a complaint was made to me of the infestation as a really serious flour-mill pest, with specimens accompanying, from which I was able to study the attack, and also to rear the moth.

On making enquiries relatively to the presence of this Flour Moth at the Mediterranean ports, I was informed that it was prevalent there where the highly glutenous Russian and Hungarian Wheats were used. How far the nature of the Wheat affected amount of caterpillar was quite beyond me to judge of, although my correspondent was well qualified to be certain as to observable facts. But thinking that, whatever might be the cause of the infestation, the presence of the pest might reasonably be attributed to it being exported with the Wheat from the country which it frequents, I wrote to Dr. Lindeman, the Russian Agricultural Entomologist, on the subject. Dr. Lindeman was good enough to reply at once that he could take on himself to state that up to that time the insect had not been observed in Central Russia, and he was not aware of its presence in Southern Russia.

The recent observations are usefully given by Mr. F. H. Chittenden,

* Ent. Zeit. Stettin, 1879.

† 'The Entomologist' for May, 1887 (No. 288, p. 139). Messrs. West, Newman & Co., Hatton Garden, London, E.C.

‡ Transactions of Entomological Society, part iv. Dec., 1887, p. lii.

Assistant Entomologist of U.S.A. Department of Agriculture, in condensed form as follows :—

"Until the year 1877, when the moth was discovered in a flour mill in Germany, it was comparatively unknown. In later years it invaded Belgium and Holland, and in 1887 appeared in England. Two years later it made its appearance in destructive numbers in Canada. . . . Previous to the Canadian invasion, this moth was generally believed to have reached Europe from America, but, as a matter of fact, the species had not been recognized here until 1889. Danysz * has traced its occurrence in this country as far back as 1880. He mentions also an outbreak in Constantinople in 1872, and presents evidence that it was probably known in Europe as early as 1840. Until the present year this insect was known as injurious on this continent only in Canada and California, but in the 'American Miller' of May 1st, 1895, Mr. W. G. Johnson states that it has appeared in New York State. It is recorded also from North Carolina, Alabama, New Mexico, Colorado, Mexico, and Chile, and probably occurs in Australia." †

The above notes show the rapidity of the spread of this mill pest in the last few years, relatively to which Mr. Chittenden remarks :— "That the Mediterranean Mill Moth has become so formidable in recent years is due to the higher and more equable temperature maintained in modern mills, a condition highly favourable to the development of the insect."

And to give yet another short extract from the same serviceable pamphlet, p. 284, the following note, which adds grain, biscuits, &c., to the dietary of the caterpillars, shows a much greater variety in nature of food than, so far as I am aware, is known of *generally* :— "Although the larva prefers flour and meal, it will attack grain when the former are not available, and it flourishes also on bran, prepared cereal foods, including Buckwheat grits, and crackers." In the same paragraph mention is made of it having been recently discovered as an inquiline (co-tenant) in the nests of a wild Humble Bee in California, and that "Mr. D. W. Coquillett reports that it also occurs in the hives of the Honey Bee."

I have drawn attention to the above by italicising the word "generally," as I am not aware that the great power of the *E. kühniella* caterpillars noticed by Mons. J. Danysz (Directeur du Laboratoire de Parasitologie de la Bourse de Commerce, Paris) of infesting biscuit

* Mons. J. Danysz, Director of the Laboratoire de Parasitologie, Bourse de Commerce, Paris, author of a valuable pamphlet on *E. kühniella*.

† 'The More Important Insects Injurious to Stored Grain,' by F. H. Chittenden, Assistant Entomologist, United States Department of Agriculture. Washington. 1895.

has been generally noticed in this country.* Nor (though to a much less degree) its power of injury to grain. With regard to the latter, an instance is given—p. 22 of pamphlet referred to—of Rye which was left unsold for two years, being found webbed up, and the proprietor, not wishing it to be wholly a loss, feeding it to a number of young pigs, purchased for the special purpose, most of which died consequently on feeding on the almost compactly massed up grain.

The injury to biscuit is recorded as on a very large scale in connection with the army supplies, and amounting at times to as much as half or the whole of the store. The details and statistics of this and the preventive measures requisite are entered on with very serviceable clearness at pp. 23–26 of work referred to.

In an instance under my own observation, which gives some idea of the steady power of multiplication of this species in favourable circumstances, some felted-up flour was sent me on or about Oct. 7th (1895), which then, so far as was noticeable, contained very little infestation, and after keeping this in my study during the winter I found on examination on April 6th in the following year that the mass of flour was webbed firmly together into a piece ten inches long and six wide, and of about an inch in depth in the thickest part, and there were at that date approximately four hundred moths in the box. Some of these were still alive, and from the freshness of their plumage obviously only recently developed, and moths continued to appear until the end of May, when the specimen passed from my possession.

The damage caused by these *E. kühniella* caterpillars spinning up the flour in which they feed, which appears to be the way in which they chiefly hurt us here, is something enormous, from the clots and lumps causing stoppages to the machinery and injurious infestation in every part of the apparatus and of the mill to which flour can have blown. In the words of one of the earliest communications sent me on this subject:—"I have got quite a plague of moths in the mill, some of which, and worms, I send you; they get into the spouts and machinery, and do no end of mischief, both by destroying the silks and stopping the flow of flour, &c., in the spouts by spinning thin web and hanging there." With us this results in losses of hundreds of pounds, and in the United States of America the losses from the same causes, which necessitate frequent and prolonged stoppages, are estimated at thousands of dollars in large establishments.

But it is not only in mills that the damage to flour is serious, for

* See '*Ephestia kühniella*, Parasite des Blés, des Farines, et des Biscuits' [Parasite of Corn, Flour, and Biscuits]: 'Histoire Naturelle du Parasite et Moyen de le détruire,' par J. Danysz. 15, Rue des Saints-Pères, Paris.

the caterpillars, which have an almost extraordinary power of dispersing themselves wherever there is suitable accommodation, are to be found in flour at bakers', and are constantly transported to and fro in sacks of flour, and likewise in the empty sacks which have carried infested flour, and which, when sent on without due disinfection, transmit the pest constantly more and more throughout the country.

The principles of prevention lie in the most extreme watchfulness against infestation being brought in (as above), and most scrupulous cleanliness and care to remove the very first beginnings of moth settlement in the mills. When established, fumigation is sometimes of service, but the danger of the use of bisulphide of carbon, and the risk of injury to the flour which may be stored in the mills in the case of use of sulphur fumigation, is very much against extended use of such measures. In very bad attack the turning on of hot steam, especially where, as in some of the Canadian treatments, arrangements could be made for the steam being "superheated," answers well as a means of getting rid of the trouble; but, at the same time, the temporary injury to the machinery, such as rusting the shafting, &c., the inconvenience of stopping the working of the mill for a time, besides the losses from this and expenses of whitewashings and cleanings of every accessible locality where the caterpillars can lodge, are a serious matter.*

The moth, *E. kühniella* (figured at p. 95) is only about one inch in expanse of the fore wings, which are of rather a pale grey with darker transverse markings; the hinder wings whitish and semi-transparent, with a darker line from the point along the fore edge.

The moths lay their eggs on flour, or on "branny stuffs," or on sacks holding flour, or the like places, and the eggs have been seen to hatch in a few days. The caterpillars, which are about half an inch in length (or a little more), when full-grown, are sixteen-footed, slender and cylindrical in shape, and vary in colour from pale red in the younger to almost white in the older specimens. The head and segment behind the head yellowish brown, the latter divided along the middle by a faint line, and above the last segment also there is a

* Details of the attack and preventive measures which have been attempted will be found in the observations of mill-owners sent to myself, and also in the Bulletin and Report on the Flour Moth issued by the Ontario Board of Agriculture consequently on the first appearance of the *E. kühniella* in Ontario in 1889, and in the Appendix to the Bulletin published at Toronto, October 15th, 1890, of which extracts are given in my Twelfth and three succeeding Annual Reports, these three containing the Canadian references regarding the operations with which I was favoured at the time with much communication. The pamphlet by Mons. J. Danysz, of which the title is given at p. 98, contains such a great amount of useful information that (if permitted by the author) I believe the publication of a translation of it whole or in part would be of great public service in this country.

brownish patch. The jaws are brown. The caterpillars turn to chrysalids in the flour in which they feed, from which the moths may come out in three weeks. The time required for the whole life cycle, that is, through condition of egg, larva, and pupa, up to the perfect insect, varies with circumstances. It may be from two to two and a half months, or, in the most favourable circumstances as to warmth, about five weeks is estimated to be sufficient.

Application for advice as to best methods of extirpation of this pest show the constantly increasing amount of spread in this country; but it is only in the past season that I have received definite observation of it as being transmitted in flour from the south and east of Europe. I therefore give the matter of the two communications, but for obvious reasons without the addresses of the importers. The following observation was sent me on October 31st:—

"I lately received from an Adriatic port two shipments of flour, which, on landing, were both found to be thickly infested on the outside of the sacks with maggots and cocoons, some full, some empty, showing that they must have been the produce of some moth."

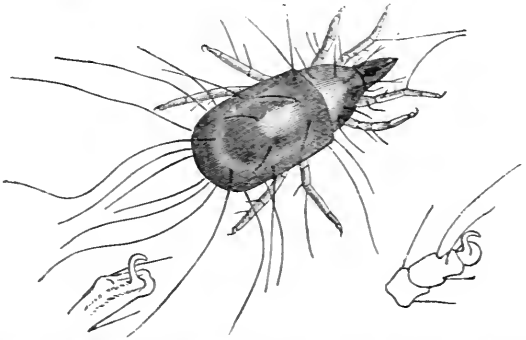
In order to be certain of the nature of the infestation as (in the experience of many years) my correspondent mentioned he had never seen it before, he collected a number of the insects in their various stages of development, as far as they could be discovered, from the sacks of flour, which he forwarded, with the note: "Box A represents the flour, and contains a few larvæ, various cocoons, inhabited and empty, some containing the shell of the pupa after the imago had escaped, and one moth, the only one I succeeded in obtaining, and it unfortunately too much injured to allow of thorough examination"; but, consequently on his study of the subject, my correspondent stated that he arrived at the conclusion that this insect is the *Ephestia kühniella*, and from my own examination of the specimens I saw no reason to doubt such being the case.

The other observation was incidental, and occurred in the course of examination of flour sent me by one of the East London firms, which involved sieving eighty-five barrels of flour, and examination at least of about thirty-five more. In the course of search as to nature of beetles which were or might be present, I came on the clotted-up flour, which is a sign of *Ephestia* presence, and on reporting my observation, my correspondents replied:—"With regard to the Mediterranean maggot we have written the Hungarian mill, calling their attention to its presence, and asking if they can explain."

In the wide distribution which has occurred of this infestation during the past twenty years, it is probably of little practical importance to connect its presence now with imports from any country; but in connection with its common name of the "Mediterranean Mill

Moth," and also the note early in our British observations (see p. 96) of the infestation being especially observed in Hungarian flours, it is of some interest to receive it *directly* from an Adriatic port and also from an Hungarian mill.

"**Hay Mite.**" *Tyroglyphus longior*, Gervais.



TYROGLYPHUS LONGIOR.—*T. longior*, from figure by Fumoze and Robin; claw with sucker of *Tyroglyphus;* right-hand side, from Murray's 'Aptera'; left-hand side, figured by Editor from life. All magnified.

The following observation referring to what is sometimes known as the "Hay Mite" (the *Tyroglyphus longior* scientifically) is the first note I have had of it being observed in connection with oatstacks. This Mite, which is very nearly allied to our common Cheese Mite, is not unfrequently noticed as having fallen from haystacks, or from hay stored in lofts, so as to lie in such great masses round the stacks, or beneath the haylofts, that the quantities of dust-like heaps could be shovelled together, and in one instance an enquirer (although the Mites are not really injurious) had been advised to burn his stacks to get rid of them.

The infestation has been occasionally reported from English and Irish localities, but chiefly from Scotland; but as I have never until last season had any notes of this Mite presence infesting oatstacks, I give the following observation of it with which I was favoured on October 2nd, from Allerston, Pickering, Yorkshire, by Mr. Herbert Prodham:—

"By the same post as this letter I send you a small box containing a quantity of little Aphis or Mites that I have got from our stack-yard. . . . There are twelve or thirteen stacks in the yard of Wheat, Barley, and Oats, but the Mites are only found lying around two stacks of Oats, having apparently dropped out of the ends of the sheaves, and are there in myriads, and in places there is a thickness

of a quarter to half an inch of them, and they have an appearance of brown washed fine sand as seen on a road after a heavy shower, and which first arrested my attention.

"They are under two stacks of Oats grown in two different fields, but they are the *same kind* of Oats—known here by the name of 'Garton Abundance.' We have a third stack of Oats of a different kind of seed, and grown in another field, but there are no insects under it.

"Since beginning to write this letter, I find from the foreman that four waggon-loads of Oats from the field out of which No. 1 stack was built were used in topping up No. 2 stack. Now No. 1 stack has the *most* Mites under it, but still there are more of them under No. 2 stack than can be proportionally accounted for by the four loads. I am curious as to whether the *kind* of Oat has anything to do with it.

"All the three fields in which the Oats have been grown followed Turnips; but the one where no Mites appear is sown with Clover seed, and the other two are not."—(H. P.)

These Mites, of which plentiful specimens were sent me, belong to the order *Acarina*, and are hatched from eggs; in their early condition they have three pairs of legs, when mature four pairs. When seen without magnifying powers they are quite indistinguishable from the common Cheese Mite; but when moderately magnified may be distinguished in a general way by being somewhat larger, also by their longer shape, longer hairs, and their greater activity in movement.

So far as appears from observations up to date, these Mites are mostly found (that is, noticed to an observable and inconvenient amount) in connection with hay which has not been heated, and also made up from what are variously called—according to local custom—cocks, tramps, or tramp ricks, &c., in which, for reasons of weather or otherwise, the hay has been gathered in the fields and left standing for some weeks, or at least for a considerable time, before being stacked.

The following notes illustrate this point. One sent me in 1891 by Mr. Thos. Fraser, from the Isle of Jura, N.B., was as follows:—

"It is the general practice in haymaking in the West of Scotland (West Highlands), as soon as possible after cutting or mowing (which ranges from the end of June to the end of August), to have the hay collected in large tramps or cocks on the field, where it is allowed to remain some time. The first appearance of the Mites (to an ordinary observer) is when removing the said cocks or tramps from the field. While forking the hay from the bottom or lower part of the cock on to the cart, at a much higher elevation, it is necessary to raise the hay *overhead*, and in minute particles, like dust, the Mites fall, and, from the backward position of the worker's head at the time, they stick or

adhere to the face in a very short time, causing itchiness or irritation of the skin. At this stage, I think, they are less in size than they are when found, a fortnight or so later on, emerging from the recently made stacks."

Mr. Fraser also remarked :—

"They have been in Rye Grass and in Meadow Grass this season, but more abundant in the former. During the month of September and early part of October they showed, or appeared to be, at their greatest strength and activity; after the middle of October they gradually showed less vitality to move or extend, until now (the beginning of November) all life is apparently gone."

This kind of Mite certainly feeds in some kinds of cheese,* and is noted by Canestrini as also feeding on other organic substance in a state of decomposition. Elsewhere it is noted as attacking an immense variety of dead and dried animal and vegetable substances; but I do not find any notes of it feeding on living vegetable matter, excepting possibly small fungi. But in some way or other it is obviously in intimate connection with the grass, or with some presence amongst the grass, of which the hay is made, and it would be of interest to trace out this point with proofs.

From Mr. Fraser's remark above quoted, as to alteration in size, the Mites appear at the season named to be approaching maturity. In samples sent to myself I have found young as well as fully developed Mites, as shown by some having only three pairs of legs instead of the four pairs which mark the mature condition.

Why the Mites leave the stacks or lofts where hay is stored in these myriads does not appear, but the accounts agree as to the vast quantities in which they are to be seen on these occasions. In the words of one of my correspondents: "About a month after" [making the stack, E. A. O.] "there were severe frosts (15° Fahr.), and the following day, on each side of the stack, there was a layer, about two inches deep and six to eight inches wide, of these Mites"; and another correspondent wrote: "I could have no difficulty in sending you a peck of them."

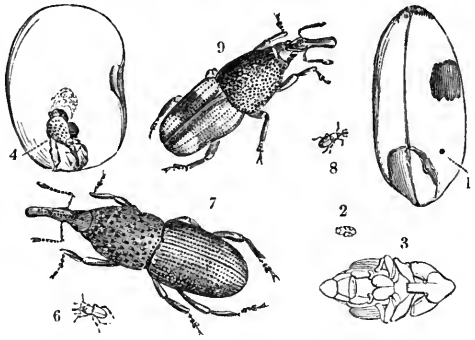
It may be possibly worth notice that these vast emigrations out of the stacks seem to end (as far at least as the observations sent to myself go) by the Mites simply remaining heaped together outside the stack (or loft) instead of being sheltered within. I have not had any observation of their line of march elsewhere being noticed, and if they did remove themselves in numbers corresponding with the vast quantities noticed, these aggregations would (demonstrably) soon be dispersed.

* See, amongst other publications, 'Prospetto dell' Acaro-fauna Italiana,' per Giovanni Canestrini, vol. iii. p. 407. Padova. 1888.

On one occasion they were sent me as being then making their appearance from a stack of Clover saved for seed, in which instance it was said that the stack "was covered with them"; otherwise, so far as I can call to mind, they have always been reported to me from ordinary or Rye Grass hay, and it has not been until the past season that I have had any notice of the Mites being observed in connection with oatstacks.

It has therefore seemed to be of some interest to refer to the infestation again, and, more especially, to give an opportunity of noting that the Mite presence has been found wholly harmless, excepting by reason of sometimes causing cattle or horses fed on the infested hay to cough from the tickling of the throat caused by the Mites in the process of being swallowed.

Common Granary Weevil. *Sitophilus granarius*, Linn.
Rice Weevil. *Sitophilus oryzæ*, Linn.



SITOPHILUS GRANARIUS and S. ORYZÆ.—6, 7, Granary Weevil; 2, 3, Chrysalis, natural size, and magnified; 8, 9, Rice Weevil, natural size, and magnified; infested grains, also magnified.

Corn Weevils are amongst the injurious insects which are constantly more or less present as a cause of much loss in imported cargoes of grain, and of a great deal of inconvenience, even where it may chance the loss is not great, in granaries and amongst stored corn generally.

During the past season enquiries have been sent me especially regarding the creatures as granary pests, and as to means of clearing the beetles (which we succeeded in doing to some degree by a very simple plan), and also regarding their presence in stored flour.

The term "weevil" is very apt to be applied to any small beetle (or, indeed, other kinds of small insects) which are found in grain, flour, or biscuits; but the term is only rightly applied to beetles, and,

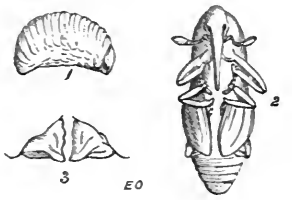
amongst beetles, only to one section, that of the *Rhyncophora*, or "Snout-bearers," which have the head furnished with a snout, or proboscis, sometimes short and broad, sometimes, as figured at p. 104, long and slender, and arched or bent from base to tip.

The two kinds of weevils which trouble us as stored grain infestations in this country were formerly known as *Calandra*, but now (with us) more commonly as *Sitophilus*, and are *Sitophilus granarius*, more especially known as *the* Granary Weevil, and *S. oryzæ*, the Four-spotted Granary Weevil, which, though called the "Rice Weevil," is mischievous in Wheat, Barley, Oats, and other kinds of grain.

The two kinds of weevils are very similar in appearance, both as to size and in variations of tint of brown or pitchy colour, excepting that the "Rice Weevil" usually is rather the smallest, and is distinguishable (see figure 9, p. 104) by having two lighter spots on each wing-case. Also, whilst the "Rice Weevils" possess ample and serviceable wings folded beneath the wing-cases, the Common "Granary Weevils" are wingless. The length of the "Granary Weevils" is from about one and a half to two lines, that of the "Rice Weevils" commonly rather less; and the general colouring of both species is some shade of pitchy black or pitchy red, or even sometimes pale chestnut; the antennæ (horns), which are elbowed and inserted on each side of the proboscis, are reddish, and the legs also are reddish. The fore body more or less pitted, and the wing-cases striate. At the end of the snout is the mouth-apparatus with which the weevils make the holes into grain for egg deposit.

The life-history (taking the Common Granary Weevil as having been most observed) is as follows. The female beetle makes a hole with her proboscis in a grain, and in this she lays an egg,—one egg only in small corn, such as Wheat, Barley, or the like; but recent observations have shown that in the case of Maize, or Indian Corn, more than one egg is deposited. It is considered that in the course of a week one female can lay up to as many as one hundred and fifty eggs. The young maggot, which soon hatches, feeds on the contents of the corn grain, clearing it all out so as only to leave the outside, and there it changes to the chrysalis state, and thence shortly to the perfect weevil.

The larvæ or maggots of *both species* are legless, white, fleshy and thick in shape (as shown in the figure accompanying), with yellow or chestnut-coloured heads, and strong jaws. In the case of the Rice Weevil maggots, the jaws were chestnut-coloured, and bluntly pointed and waved into two blunt teeth.



Maggot and chrysalis, and jaws of maggot of Rice Weevil; magnified.

The rate of multiplication of the weevils is variously stated, and probably is much influenced by circumstances, and most particularly whether the temperature is raised to the height favourable to development. One record of observation of time taken by the *Calandra* (*Sitophilus*) *granarius* for development from egg to beetle is forty-one days, another is of thirteen weeks; and it is stated that this species will not pair in a temperature of under 52°. In a case of some observations of my own as to development of Rice Weevils extending over fourteen months, during which I kept the infested Wheat in a living room, used in winter as well as summer, I only obtained one brood.

It adds very much to the destructiveness of this infestation that the *beetles as well as the maggots* feed on grain of different kinds, as Wheat, Oats, Barley, Rye, Maize, &c.; and with regard to the "Rice Weevils" the variety of food which they attack is thus stated:—

"The adult beetles attack a great variety of food products *not affected by the larvæ*. When abundant in storehouses and groceries they invade boxes of crackers, cakes, yeast cakes, macaroni, and other bread-stuffs, barrels and bins of flour and meal, and can subsist for months on sugar. They are even said to burrow into ripening and over-ripe Peaches, Grapes, and Mulberries, and to attack Hemp seed, Chestnuts, and table Beans." *

During the past season I received from one of our East London importing firms a consignment of various kinds of beetles which had been found in flour, for identification, and amongst these were specimens of the *Calandra* (*Sitophilus*) *granarius*. There is no reason, so far as I am aware, to suppose that these weevils lay eggs or live in maggot state in flour, still their presence is objectionable in any case, and especially to importers, where, under the rules of the Merchant Shipping Provisions Act, even the presence of very small numbers in a barrel of flour causes its rejection.

In this instance the eighty-five barrels of flour had to be emptied, the flour sieved and repacked, destroying all foreign matter. The infestation was exceedingly small in amount, as the weevils collected from the above amount of large barrels only amounted to about enough to half fill a small phial. In itself (save for breach of regulations) it would have been unimportant, but, entomologically, the observation was of some interest.

The weevils sent me caught my attention as varying to some slight degree from the typical form of Granary Weevil (*Calandra* (*Sitophilus*) *granarius*), and to be absolutely sure of the species I submitted them to Mr. O. E. Janson, of Great Russell Street, E.C., who was good

* 'The More Important Insects Injurious to Stored Grain,' by F. H. Chittenden. See note, p. 109.

enough to examine them and reply as follows:—"The *Calandra* I at first thought might be distinct from the *granaria*, L., but now I have examined a larger series, I find there is some variation in the form of thorax and other points, and therefore conclude it is that species."—(O. E. J.) The "Rice Weevil" was also just represented.

On further communication with the docks, it was stated that oil-cake next to which the flour had been stored was swarming with weevils. The oil-cake had lain there eighteen months, and apparently had formed congenial quarters. This point I had not the opportunity of examining on the spot myself, but looking at the long time for which these weevils will live, certainly for months, and it has been stated, by various observers, for more than a year, there is no reason to doubt that the stored cake might be used for harbourage, and serve as a centre for spread of mischief, although not for breeding purposes, and the great inconvenience which arose suggests that search as to what may be present in storage localities before sending in large amount of valuable imports, would sometimes be of more use than is generally thought of. And also that in a case like this it would be well not to allow a weevil centre to remain undisturbed for months.

As pests in corn cargoes, and in grain stores, and in granaries down to the smallest where grain can be stored, we have long been well acquainted with the mischief caused by these weevils; but I just add one of the notes of their presence sent last year showing them as a trouble in the winter stock of food laid up for horses. This was sent me on September 29th:—

"I shall be much obliged if you can inform me how I can get rid of weevils which have appeared in great numbers among my Oats in my granary, not a large one. I have about fifteen quarters of Oats in stock. The weevils run about them and up the walls and ceiling. I have tried spreading some of the Oats on the floor thinly, and then fumigating the granary with brimstone, as in cases of fevers, or dirty houses, &c. However, this seemed to have no effect on the weevils, though the room was kept closed all night, but they were as lively as possible next morning on the walls, &c. I thought of putting the Oats on a malting floor, but I was told that the heat required to kill the weevils would spoil the Oats. Any suggestion you can make I should esteem of great value, as these Oats are my winter stock for my hunters."—(H. A. W. N.)

Prevention and Remedy.—In the above-mentioned difficulty the chief point desired is to get rid of the weevils, and in the course of the past season I suggested trying for this on a small scale, the plan which is described as follows on a very large one in unloading infested cargoes:—"When the cargo is very badly affected,—when the whole

bulk seems alive, as I have myself seen them on very hot summer days,—it is a common practice for merchants to spout it—*i. e.* to shoot the grain down a spouted trough, in which, at the angle, is a wire sieve with meshes large enough to let the weevils pass through, but not the corn, which runs into the granary or into sacks, as the case may be.

"By such means the quantity of weevils and dust sifted out is enormous; and this appliance is generally so situated at the wharves that the beetles are deposited near the edge of the wharf, or even in the river bed, and if not naturally washed away at high tide are swept into the water, their destruction being thus easily accomplished.

"The great heat generated in a bulk of weevilly corn is caused by the dust arising from the borings and 'frass' of the insects. The weevils themselves are generally to be found inside the granaried heap or cargo of corn, unless the weather is very hot, when they are especially lively on the outside."—(E. A. F.)*

On a small scale there does not seem to be any difficulty in carrying out this plan as well for farm use, or in private establishments, as in the great shipping arrangements; and last season I suggested running weevilly corn down a screen made especially for the purpose so as to allow the beetles to go through but not the corn, and I was told that the plan succeeded. The great point to be attended to would be that the weevils should fall on what they cannot escape from, but a tub or rather a shallow vat of the length and breadth of the screen, and placed beneath it with a mixture of soft-soap and paraffin in water, or anything which would stifle the beetles, would answer every purpose, and not be of much expense.

As matter of prevention of infestation, fresh grain should never be stored in bins where infested grain has been, or in buildings where weevils are then present, as they have a power of spreading with wonderful rapidity. All bins in which weevilly corn has been stored away should be cleared of all remains of the grain and thoroughly scrubbed, brushed, and cleaned in every available way.

Lime-washing and scrubbing granaries (especially with soft-soap), plastering up all crannies and uneven wall surfaces so as to prevent the weevils sheltering in them, and for a similar reason concreting or asphalting all uneven floors, are measures strongly recommended. Also where storage rooms or granaries are large and steam power is available, it might be expected that the application of steam by means of a hose, and at the greatest heat attainable, would act well in clearing out this attack, as it has been found to do in mill service for clearing out the "Mediterranean Mill Moth," and also such of the

* From "Granary Weevils, *S. granarius* and *S. oryzæ*," by Edward A. Fitch, 'The Entomologist' for February, 1879, pp. 42–43.

cheese vermin which shelter between the boards or other crannies in large cheese rooms.

The use of the dressing machine or blower is also recommended to clear the infested grains.

In regard to the application of heat as a disinfectant.—It is stated that Wheat can be subjected to a temperature of 150° without destroying its germinating power, and (without acting on this save with due experiment) it may prove that this would be a serviceable way of destroying the weevil maggots in the grain, which are very hard to reach by most methods of treatment.

In regard to fumigation generally, or deterrents by means of strong vegetable or chemical scents, the utility of a large proportion is very doubtful.* Also some that in themselves are, or might be, useful as insecticides, as sulphur, for instance, or naphthaline, are of limited use, from their capability of injuring the nature of the flour, or imparting so strong a scent to the grain as to make it undesirable for food.

The fumigant, of which the use has been steadily gaining ground both in the United States and in Canada for many years, is bisulphide of carbon. Of the method of application of this I have given notes in previous Annual Reports in extracts from the Bulletins or Reports of the Ontario Board of Agriculture; but the following extract from Mr. Chittenden's pamphlet contains serviceable information, both as to the nature of the application, and likewise the *great danger* from its inflammability, and also the *risk to health and even to life* if carelessly used:—

"*The bisulphide of carbon.*—The simplest, most effective, and inexpensive remedy for all stored grain insects is the bisulphide of carbon. This is a colourless liquid with a strong disagreeable odour. It vaporizes abundantly at ordinary temperatures, is highly inflammable, and is a powerful poison.

"The most effective manner of applying the re-agent in moderately tight bins consists in simply pouring the liquid into shallow dishes or pans, or on bits of cotton waste, and distributing about on the surface

* For a list of these, under the heading of "Repellants, Counter-odorants, and Lure Traps," see Mr. F. H. Chittenden's pamphlet on 'The More Important Insects Injurious to Stored Grain,' referred to in note, p. 97. This pamphlet of about twenty pages is strongly to be recommended to all interested in insect grain attacks. It gives short accounts of about twelve grain or flour infestations, giving the most important points connected with them, and also figures of the greater number, and to these are added about four pages of remedies. It is in my opinion an excellently useful work, and where any intending purchaser should have difficulty in procuring it from his own bookseller, probably from the connection of Messrs. W. Wesley & Son, 28, Essex Street, Strand, London, E.C., with the special subject of supplying American agricultural publications they would have no difficulty in supplying it or procuring it.

of the grain. The liquid rapidly volatilizes, and, being heavier than air, descends and permeates the mass of grain, killing all insects, as well as rats or mice, which it may contain.

"The bisulphide is usually applied in tight bins at the rate of a pound to a pound and a half to the ton of grain, and in more open bins a larger quantity is used. . . . Bins may be made nearly air-tight by a covering of cloths or blankets. Oilcloth and painted canvas are excellent for this purpose.

"Mills and other buildings, when found to be infested throughout, may be thoroughly fumigated and rid of insects by a liberal use of the same chemical."

Mr. Chittenden here notes, amongst other things, that the doors and windows should be closed as tightly as possible, and a *watchman* stationed without to prevent anyone from entering the building, and he also gives the very necessary caution that the building should be thoroughly aired early in the morning before the return of the workmen.

To continue the extract from Mr. Chittenden's paper:—

"It is best to begin in the lowest story and work up, in order to escape the settling gas. . . . The bisulphide is usually evaporated in vessels, one-fourth or one-half of a pound in each.

"Infested grain is generally subjected to the bisulphide treatment for twenty-four hours, but may be exposed much longer without harming it for milling purposes. If not exposed for more than thirty-six hours its germinating power will be in no wise impaired. In badly infested buildings it is customary to repeat this treatment about every six weeks in warm weather."—(F. H. C.)

The bisulphide treatment has long been considered as one of the most valuable methods of disinfection both in Canada and the United States, but I have hesitated to bring it forward on account of the danger both to human health and even life, and also the great danger to property consequent on its extreme inflammability, unless used with both care and knowledge.

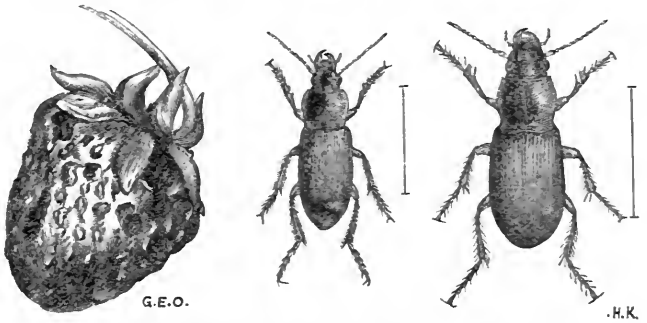
How far its use may vitiate an insurance I do not know, but it will ignite in temperature heated up to a certain point even in the absence of light from fire, lamp, &c., and even the light of a cigar will or may cause ignition; and in experiments of my own I have seen a specimen dressed with the fluid ignite merely from exposure to the sun's rays in the open air.

One other point remains to be noticed, and that is infestation by means of screenings from foul corn, sold cheap, carrying infestation around in the neighbourhood of mills. These, according to their nature,—as the small broken bits of straw sold for pigs' bedding, the mixture of small shrunken Wheat, with broken grain and chaff, sold

for feeding poultry, or the very miscellaneous collection of bodies larger than corn grains, sometimes known as "rubble,"—may or do spread pests wherever they are taken, and are to be looked on with great suspicion.*

STRAWBERRY.

Ground Beetles—"Bat Beetle." *Harpalus ruficornis*, Fab.; *Pterostichus* (*Omaseus*) *vulgaris*, Linn.



HARPALUS RUFICORNIS (left hand), and PTEROSTICHUS VULGARIS (right hand), magnified, with lines showing natural length. Strawberry fruit gnawed by *H. ruficornis*.

In the year 1894 accounts were sent to me of much mischief caused by various species of "Ground Beetles" (duly identified at the time) to Strawberry fruit at Woodborough in Nottinghamshire. In this instance the farmer watched for the cause of the mischief, and detected the beetles swarming on the fruit by night, which they devoured to such an extent that the crop of three roods was ruined.

In 1895 the attack reappeared to a much more serious extent, for it showed itself at many places in the above district, and injured the Strawberry fruit to such an extent, just when it was beginning to ripen, as to cause severe losses.

In 1897, that is, the year now past, the specimens and reports forwarded show this great trouble to Strawberry growers to be not only still present and injurious in the district where it was first observed, but also to be much more widely prevalent. In this county (Hertfordshire) the beetles appeared in great numbers in the early

* See my 'Twelfth Annual Report on Injurious Insects,' article "Screenings," pp. 56–65.

part of June at two localities, respectively, about two and a half miles in a north-easterly and two miles in a south-westerly direction from St. Albans, and also elsewhere in the district. In Norfolk they were reported in two localities. In Nottinghamshire they reappeared as again seriously mischievous. In Bedfordshire they were reported from one locality as a great trouble on a large acreage, with the remark that it was believed to be a general complaint. I had also information of the total destruction of a fruit-grower's crop near Tewkesbury, Gloucestershire, and similar destruction of three-quarters of an acre near Ringham, Berks.

A glance at the position of the above localities on a map will show the widely increased prevalence of the pests over the country.

The species of "Ground Beetles" sent me during 1897 for identification were the *Harpalus ruficornis* and the *Pterostichus* (*Omaseus*) *vulgaris*, figured at p. 111, magnified, with lines showing full natural length, which is somewhat variable.

The *Harpalus ruficornis* is 6–7 lines long, pitch black, with the long horns and long legs usually red; the thorax is thickly punctured at the base, and the hinder angles acute; the wing-cases are faintly striated, and are thickly covered (whilst the specimens are fresh) with golden or greyish down. *Beneath the wing-cases are ample wings, which they use freely for flight.*

The *Pterostichus vulgaris*, also figured at p. 111, is rather larger than the foregoing, and is $6\frac{1}{2}$–$7\frac{1}{2}$ lines, or possibly more, in length. Wholly black, and rather shining. Thorax rather broader than long, hinder angles bluntly pointed; wing-cases strongly and smoothly striated. *No wings.*

Descriptions of other species of beetles of which specimens were sent me as injurious to Strawberry fruit in 1895 will be found in my Annual Report for that year.

These beetles belong to a section (the *Geodephaga* scientifically) which, quoting from Mr. Rye* as a leading authority, "superficially may be known by their active habits, slaughtering propensities, thin legs and antennæ, and hard outer covering. They . . . may be considered as the carnivora of the beetle race; passing their lives, both in the larval and perfect state, in the pursuit and destruction of their weaker insect brethren. . . . The larvæ of the *Geodephaga* are but little known; they are, however, mostly found in the same places as the perfect insect, and are equally carnivorous and active. A geodephagous larva is usually flat, elongate, parallel-sided, fleshy, with the head and first segment hard; . . . the legs are horny, six in number, and situated on the first three segments; . . . there are powerful sickle-shaped jaws, and the apex of the body has usually

* 'British Beetles,' by E. C. Rye, pp. 44 and 46.

two horny or fleshy appendages on its upper surface, the lower part being lengthened into a membranous supplemental leg. The pupa is generally (if not always) formed in a cell underground, and is rarely met with."—(E. C. R.)

Some of this section, however, have been found during the last few years to be also vegetable feeders to an injurious extent, and in the case of the two kinds mentioned at p. 111, anyone who wishes to see for himself that they are both Strawberry and animal feeders may satisfy himself by keeping some specimens without food until they are hungry, and then introducing food into their cage.

In my own experiments I found that on dropping a few worms among the hungry beetles that one of the *Pterostichi* seized a little worm for its own special prey, setting its legs firmly so that it could drag the creature along, whilst most of the rest of the beetles made a simultaneous attack on an earthworm which was about four or five inches long, and settling themselves in little parties with their heads opposite to each other, pulled with their strong jaws until they soon tore through the skin. They also eat uncooked as well as cooked meat and cooked fish.

I found that both kinds preyed greedily on Strawberries, and a party of the *Harpalus ruficornis* lived for seventeen days on nothing but Strawberry fruit without, so far as I could see, suffering in any way from this diet; but neither of the two kinds of beetle would apparently even taste any of the other kinds of fruit which I placed in their jar.*

The damage caused to the Strawberry crop is by attack of the beetles both to the green and ripening, and also the ripe, fruit. With the green fruit they will even clear the skin; and with the ripe fruit they are particularly partial to attacking the seeds, and likewise gnaw large or small holes, as the case may be, in the substance of the fruit (see figure, p. 111), so that the fruit in all probability turns moist and rots, but certainly is quite ruined for purposes of sale.

The first information sent me regarding observation of Strawberry "Ground Beetles" in the course of last year was given me by Mrs. Broadwood, of Bone Hill, St. Albans, a friend and neighbour, who, on June 14th, brought me over a number of specimens, which, on examination, proved to be *Harpalus ruficornis*. These were part of such a very numerous appearance that it was described as a swarm, of which so many fell at 10 p.m. on the previous evening on members of the family sitting in front of the house, that it was supposed the beetles were tumbling from the roof. A search was going to be set on foot as to possible lurking-places, but the weather turned colder,

* For minute details of experiments, see paper on "Strawberry Ground Beetles" in my 'Nineteenth Annual Report.'—E. A. O.

and the beetles did not reappear in this manner, but were mentioned to be all about the neighbourhood, and especially reported by a gardener living close to a wood near Park Street. This is a village about a mile (as the crow flies) south of St. Albans; Bone Hill is about two miles to the south-west.

Later on, enquiry was made me by the Rev. J. A. Cruikshank, Vicar of Sandridge, a village not quite three miles to the north of St. Albans, as to the nature of a very great quantity of large dark brown beetles which had appeared in June, and completely destroyed his very promising Strawberry bed. On showing Mr. Cruikshank my type specimens of Ground Beetles, he picked out those of the *Harpalus ruficornis* as similar to those which had done the mischief, and at my request was good enough to give me the following note of the great numbers in which the beetles appeared, and the great amount of mischief which they caused:—

"The *Harpalus ruficornis* made its appearance in this way early in June. I noticed a sound as of heavy drops of rain falling on the step of the garden door; on inspection, I found that the sound was caused by scores of beetles falling from the walls of the house; apparently they had flown against the wall and then fallen to the ground. About the middle of June my gardener noticed great numbers of them on and about the Strawberry bed; they remained in the soil during the day, and came to the surface at night. They first attacked the Strawberry beds when a few berries were ripe, and then turned their attention to all the berries, whether green or ripe. The whole crop, an exceptionally good one, was destroyed in less than a week. After they had done all the mischief they could, they disappeared, but a few are still to be found in the soil at the date of this letter."—(J. A. C., Sept. 20th, 1897.)

A little later than the date of the above appearances of the *H. ruficornis* to the north and south of St. Albans, I found a small amount of injury to Strawberry fruit in my own garden, which lies on the southern slope of Holywell Hill in St. Albans, just outside the town; but I did not notice presence of any beetles, possibly because I was seldom in the garden in the evening.

On July 6th I was favoured by the Rev. T. E. Platten, writing from Hindringham Vicarage, Walsingham, Norfolk, with the following communication, showing, like the preceding one from Sandridge, the speed and thoroughness with which a visitation of these beetles (*H. ruficornis*) clears off a promising crop of Strawberry fruit:—

"I am sending for your inspection some Strawberries gathered from my bed. I had a most splendid show of fruit, and now I find that nearly all the berries are like those I am sending, and there is not a Strawberry on the bed worth eating. I am also sending you in

the box some specimens of beetles with which our house is this year infested. Is it likely that the damage to the Strawberries is done by the beetles? . . . I may mention that I have heard of several other cases of the destruction of the Strawberry crop in the same way in this neighbourhood."

The beetles sent me by the Rev. T. E. Platten proved to be specimens of the Strawberry "Ground Beetle," the *Harpalus rufi-cornis*, and on furnishing them with ripe Strawberries, they attacked the fruit as I had seen on previous occasions. One patch of five-eighths of an inch long by about half that breadth was eaten away on the outside of one fruit; and in another case one of the beetles fairly buried itself in a large hole which it gnawed right through in a fruit, the end of the tail of the beetle showing at one end, and the head coming out just beneath the calyx at the other.

On July 9th Mr. Platten wrote further regarding the beetles:—

"My man and I yesterday searched a crack in the ground in the Strawberry bed, and in about a foot or eighteen inches found a dozen. There were two kinds, one the same as those I sent, *Harpalus rufi-cornis*, and the other a larger and blacker beetle, but there were only two or three of these.* The ground in many places is covered with a powdery dust,—the seeds eaten off the berries. As to the cause;—no town manure has been used on the beds or anywhere in the parish, I feel sure. The bed is infested all over, as far as I can see; about one-third was newly planted last autumn, the rest was not dug, but there does not appear to be any difference in the number of beetles. It is not due, I think, to the scarcity of moles, I seldom knew them so numerous as last year. Last autumn, in two of the fields near, I noticed several times very large flocks of starlings, and I thought then that there must be a very plentiful supply of food of some sort for them. I do not know whether there could be any connection between the two things. . . . I find the beetles do eat one another; a dead carcase is greedily attacked at once."

In regard to possibility of poisoning the beetles by a mixture of red lead made up into a paste with flour, which had been mentioned as sometimes answering for destroying beetles, Mr. Platten wrote me on July 12th:—

"Red lead has no effect upon the beetles. I mixed flour, dripping, and the lead into a paste, and gave it to some in a box; they at once devoured it greedily. That was on Saturday. This morning (Monday) they are as lively as ever."

* Conjecturally, these beetles might be *Pterostichus vulgaris* or *P.* (*Steropus*) *madidus*, both of which species are black, and somewhat larger than the *H. rufi-cornis* (see p. 111); but as I had not specimens for examination, I cannot be certain.—E. A. O.

The following note from Mr. S. B. Burroughes, one of my regular correspondents for several years, shows presence of beetle attack on Strawberries at yet another Norfolk locality,—Cley-by-the-Sea, Holt.

Relatively to some injury which was going forward amongst root crops apparently similar to damage sometimes caused by one or more kinds of "Ground Beetles" to Mangold plants, by biting them off just beneath the surface of the ground, I was at the time in communication with Mr. Burroughes, who examined the beetles carefully, and told me that they were of the kind I named (*i. e.* Ground Beetles of one of the kinds named above), and he further added:—

"The same beetle has been most destructive amongst the Strawberries this year; . . . I had seen them before, but had no idea they eat vegetables."

On July 13th, in reply to my enquiries, I was favoured by the following short note of continued presence of the attack from Mr. M. J. R. Dunstan, Director of Technical Instruction for the County Council of Nottinghamshire, who in 1894 and 1895 had forwarded me information of mischief caused by Ground Beetles to Strawberry fruit at Woodborough in the above county (and in 1895 also to other places in the district) to a serious extent. Mr. Dunstan wrote:—

"In reply to your letter, the attack of the beetles on the Strawberries this year, though not so bad as in previous years, is yet very serious, acres of good fruit being spoilt by being nibbled so as to render it unsaleable. Locally, the attack is put down to the destruction of moles, which seems to have been indulged in generally. Your account of other attacks is very interesting; it seems as though the pest is spreading."

On October 21st the following observations of beetle damage to Strawberries were sent to me by a large firm of nurserymen in Bedfordshire, whose address I have not given, as they would prefer it omitted. The specimen forwarded was of the *Pterostichus vulgaris* (see figure, p. 111), one of the kinds of Ground Beetles which is known to attack Strawberry fruit, and which may vary in size from just a little over half an inch in length to about three-quarters. Messrs. —— observed:—

"Last summer we were also much troubled (and we believe it was a very general complaint) with the ravages of a black beetle, a small one of which we beg to send you herewith. As you will see, it has eaten the seed only of the unripe fruit, and we found large quantities of green fruit so attacked, simply the seeds being hollowed out; but this caused the fruit not to swell." [It was mentioned that many of the beetles were larger than the specimen sent.] "We have tried catching them by means of basins let in level with the ground and baited, and have caught a considerable number; but as we have a

large acreage, this is a slow and expensive process. . . . They seem very retentive of life, as some lived in water for two or three days. They appear to lie dormant in the winter, and come out again in the spring."

From a fruit-grower near Tewkesbury I had the following enquiry during the autumn, which appears (although I had not specimens sent for identification at the time of the attack) to refer, without doubt, to the same infestation.

"Will you kindly inform me whether I can apply anything to my Strawberry beds to kill or drive away a small beetle commonly called in this neighbourhood the 'Bat Beetle'? In colour it is of a dull black, with reddish brown legs; and it eats the surface of the growing Strawberry, continuing from the time the fruit is just beginning to swell until it is ripe. My crop was totally destroyed last season through this pest. The soil in my garden is a rich sandy loam. There are plenty of moles, which I encourage to destroy beetles, grubs, &c."

A few days after, on receipt of such information as I was able to furnish him with regarding method of "Ground Beetle" attack to Strawberries, my correspondent replied:—

"I think it has furnished me with the reason why my crop of Strawberries should be entirely ruined and my neighbours' plantations should be *almost* entirely free. The variety of beetle that I found in my beds, according to the description, is the winged variety (*Harpalus ruficornis*); and as they are a carnivorous beetle, I can quite see that I have been attracting them from all over the neighbourhood, as I have been using blood fresh from the slaughter-house for my fruit trees on each side of the Strawberry plats, and as I discontinued the use of it as the warm weather came on, the beetles remained to eat the Strawberries."

During December I received the following communication from West Ringham, Berkshire, with specimens of the beetle which had caused the damage in the preceding summer accompanying:—

"I grow about three-quarters of an acre of Strawberries for sale, and last season the fruit was all spoilt by little beetles, such as I now enclose (which were glossy black on the back with red legs); they seemed to eat the seeds, and then the fruit withered away. I did not gather a bushel off the whole place. . . . They were not to be seen on the surface in the daytime, apparently burying themselves about an inch underground, but at night they were very busy. The ground between the plants has now (Dec. 31st) been dug, and we saw nothing of them; but perhaps the eggs are there. . . . I may say both early and late kinds were equally affected."

The specimens, which were in very good order, so that they still preserved the somewhat golden down on the wing-cases, agreed well

both with descriptions and with my type specimens of *Harpalus ruficornis*, and on lifting the wing-cases the large wings folded beneath them were very observable.

Summary.—On looking over the notes of practical observation, there are several points worth notice.

One is that—of the various kinds of "Ground Beetles" of which we have as yet had definite report, from identification of specimens, as attacking Strawberry fruit—*one kind only is serviceably winged.*

This is a very important matter, as in the case of attack from wingless kinds it is plain that the beetles must either have been bred on the place, or must have been brought in in manure, or in some way transported on to the ground either in egg or in maggot, or in some stage of beetle life, and therefore it might certainly be hoped that, by attention being paid to this matter, the feeding material of the maggot and the depth at which it works below the ground might be discovered, and thus the grubs might be got rid of before the time arrived for them to go through their changes to their Strawberry-destroying beetle state.

For description of the general characteristics of the larvæ (grubs) of "Ground Beetles," see p. 112.

With regard to the winged kind: this is the Harpalus ruficornis, and those who will be at the pains to unfold the wings from beneath the somewhat downy wing-cases, will find them large and well-developed organs of flight.

I am not aware of our having had observations until the past season of this species appearing in what were described as "swarms"; but in the case of the great numbers which were noticed at Bone Hill, near St. Albans, at 10 p.m. (see p. 113), I had personal opportunity of identification of them as being the *H. ruficornis;* and just about the same time they were observed (see p. 114) falling by scores, as if they had struck the house wall in their flight, at Sandridge, about five miles distant from the first-named locality.

So far as our observations of this past year and of 1895 show, the Ground Beetles, of which the species most reported is the *H. ruficornis*, begin their work in the evening, and their capability of coming in great quantities and so late as 10 p.m., would give a reason why the most scrupulous endeavours to clear out the infestation of such unaccountably large numbers of beetles were found useless.

In one of the special reports of 1895 by Mr. Rice,* he mentioned:—"The beetles are without number, and seem most active an hour after dark, being full and dormant at break of day. . . . The beetles

* See my 'Nineteenth Annual Report,' p. 85.

lie round the plant and under the earth, which is covered with straw and litter, having their holes and runs through the earth and litter, the opening being through the litter, and just under the bunch of fruit attacked."—(W. R.)

At Sandridge, in the past year, it was observed: "They remained in the soil during the day, and came to the surface at night."—(J. A. C.)

At Hindringham, Norfolk, my correspondent mentioned: "My man and I yesterday searched a crack in the ground in the Strawberry bed, and in about a foot or eighteen inches found a dozen."—(T. E. P.)

Another correspondent from near Wokingham, Berkshire (p. 117), noticed: "They were not to be seen on the surface in the daytime, apparently burying themselves about an inch underground, but at night they were very busy."

These various notes point to them as being regular night feeders, and the name of "Bat Beetles" given them in one locality draws attention so serviceably to their evening and nocturnal appearances, that I have added it at the heading in addition to the scientifically accepted name of "Ground Beetles" for this whole section of *Geodephaga*.

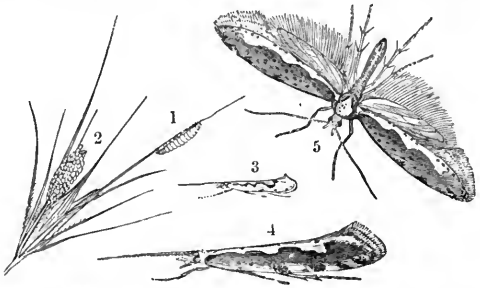
Measures of prevention and remedy which could be brought to bear on a broad scale are greatly needed. The most successful treatment appears to be putting down pieces of flesh covered with bits of thick sacking; this is said to attract large numbers, which can easily be removed and killed each morning. Another plan of trapping is to sink vessels below the ground-level, into which the beetles fall, and are killed by some destructive mixture within. Also, from the way in which they have been found in large numbers on the surface of water, it might be worth trying whether they would be attracted by means of pans of water placed on the Strawberry beds.

Opinions appear to differ as to serviceableness of moles; from the wing-cases of the beetles being found in the rejectamenta of the moles, there appears to be no doubt that they devour the beetles if so disposed, but there is no mass of evidence as to benefit from their presence. The only way in which to get at the pests in the ground really serviceably appears to be watering with some chemical which would not be hurtful to the plants, but be destructive to the pest in its pupal state, in which it is lying unprotected by any hard skin, and also unable to move, shortly before its change to beetle condition. There might be a chance of this doing good, just as by sprinkling kainite the development of one or two kinds of insects may be checked very beneficially.

But at present we do not, I believe, know the exact appearance of the Strawberry beetle larvæ, or of the pupæ, nor where they lie, nor how long they take for their changes, and we are greatly needing more information to check the increasing prevalence of this destructive pest.

TURNIP.

Diamond-back Moth. *Plutella cruciferarum*, Zeller.



PLUTELLA CRUCIFERARUM.—1, caterpillar; 2, eggs; 3, Diamond-back Moth (all natural size); 4, 5, Diamond-back Moth, at rest and flying (magnified).

During the past year there has been once again some amount of mischief from infestation of caterpillars of the Diamond-back Moth on leafage of Turnips and Swedes; but this has been nothing to compare in magnitude with the attacks of 1891 and 1892, nor so widely prevalent as that of 1894, which, though not of any great importance, was present at a good many localities, from the edge of the New Forest in the South of England to as far north as St. Andrew's and Anstruther, Co. Fife, N.B., and to the neighbourhood of Aberdeen.

But, as was the case with previous attacks, such small amount as there was last year was mostly on land in the neighbourhood of the sea-coast. The district of Ballachulish is on Loch Leven and Loch Linnhe (an inlet of the sea), in the West of Scotland; Seafield and Aberdeenshire generally, in which county the Diamond-backs did a good deal of injury to the Turnip crop, is nowhere far from the sea; and Arbroath (Co. Fife) is on the sea-coast in the East of Scotland. The only English observation sent was from near Scarborough on the sea-coast in Yorkshire.

The first communication was sent me on July 14th by Mr. W. W. Anderson, from Ardsheil, Ballachulish, Argyleshire, N.B.:—

"The enclosed is, I believe, a Diamond-back caterpillar. I found

it on a field of Swedes to-day. As in 1894, my attention was drawn to this field by the constant presence of Gulls. In addition to the Herring Gull, Common Gull, and Kittiwake, I noticed a few Black-headed Gulls, an uncommon variety in this district,

"The Turnip leaves are very much cut, but I have not been able to find many caterpillars. For the last two years we have not been affected by this pest, and the Turnip fields have been unoccupied by Gulls; so that everything tends to confirm my previous proposition, namely, that the Gull is in search of the caterpillar.

"I fear, however, that the remedy is rather drastic, for the Swede leaves in some places are badly cut, suggesting the nip of a bird's beak rather than the ravages of a caterpillar.

"P.S.—I have omitted to mention that although the Swedes and Yellow Turnips are both attacked, and the Gulls are feeding indifferently amongst both kinds of roots, it is only the Swedes that have apparently suffered from the birds' bills. Have the Gulls greater difficulty in removing the caterpillar from the Swede leaf than from that of the common Turnip?"—(W. W. A.).

The sample sent was of Diamond-back Moth caterpillar, then beginning to spin up, and in all probability, the attack being for the most part come to the stage of spinning for change to the chrysalis state, would be the reason why, although so much damage had been done, yet at the time so few caterpillars were observable on the leafage. The thin whitish webs of the chrysalis cocoons are not nearly so observable as the green caterpillars. In the sample sent me the web was completed by Sept. 17th, the day after receipt, and was so fine and open that I could easily see the characteristic markings on the pale head, and on the next segment, through it.

On July 20th, Mr. Anderson favoured me with a further note that in the course of further examination he had come across a few more caterpillars, and that most of the Gulls had left the field, although a few still remained; and that it appeared as if no further damage had been done to the crop (at least to any appreciable extent) since date of his previous letter.

On July 20th, in course of examination of some Turnip leafage sent to me by Sir William Gordon, Bart., of Earlston House, Kirkcudbright, N. B., relatively to a much distorted growth conjecturally caused by injury from *Cecidomyia* (Gnat-midge) larvæ, I found a few specimens of caterpillars of Diamond-back Moth present, although the leafage sent had not been much eaten. The caterpillars were full, or nearly full grown, and still of a beautiful apple-green colour.

On Aug. 21st the following observation was sent me, with specimens of Diamond-back caterpillars about fully grown and cocoons in

some instances containing the partly developed moth accompanying, by Mr. John Browne, from Peasiehill, Arbroath, Co. Fife, N.B. :—

"As the leaves of the Swedish Turnips in many fields in this district are getting badly destroyed, I forward you some of the affected leaves; underneath the leaf you will notice the insect in the cases.

"When they come out of the case and are disturbed they drop down on a slim cord to the ground."—(J. B.).

Enquiries as to the name of the pest, and circumstances favourable or otherwise to its increase, were added.

In this instance the caterpillars were apple-green and about full-grown. The cocoons were attached to the leaf, and in some the change of the chrysalis to the perfect moth was so far advanced that the form of the wings folded beneath the body could be clearly seen, and colouring had begun. As in this attack the condition of the infestation was manifestly (from the various specimens sent me) passing from caterpillars in their active condition to the spun-up state, it is probable that those noticed as leaving their cases or cocoons had only just begun their spinning operations.

The leaves forwarded were not very much injured, but the characteristic method of injury of Diamond-back caterpillars, by gnawing away the under part of the substance of the leaf and leaving the upper cuticle as a film, was quite noticeable.

The following observations regarding a somewhat severe attack of the same infestation in a district near Aberdeen was sent to me on Sept. 15th by Mr. H. Simmons, from Monaltrie Villa, Seafield, Aberdeen, N.B. :—

"Having noticed that a great number of fields of Green-top Yellow Turnip in this district were suffering from some kind of blight, I carefully examined a lot this morning, and found that the damage was being caused by a very small green caterpillar which attacks the foliage. I have taken the liberty to send you per parcels post the top or leaves cut from one of the above-mentioned Turnips, also a few specimens of the caterpillars."—(H. S.).

Enquiries as to nature and means of prevention of the attack were added.

The specimens sent were very characteristic. The caterpillars, which were numerous, were for the most part nearly or quite full-grown, of an apple-green, the head pale and spotted, and the segment behind the head with very minute dots. The body of the caterpillar with a few black bristles, and the caudal prolegs spreading apart. Some of the caterpillars had woven their long light cocoons almost entirely by the midrib (as far as I saw) of the Turnip leaves, and the chrysalis or moth was quite distinguishable through the open network.

Some pieces of injured leaves were sent to show the kind of damage, and likewise the leaves taken together with a slice of the top from one Turnip. There were above fourteen in number, and most of them about twelve inches long. These showed much damage from the caterpillar gnawings, the workings being as is usual from the back of the leaf, so as in some cases to leave (in patches) only a film of the upper skin, and sometimes towards the end of the leaves they were a mere ragged mass composed of remains of the skin, and the veins, which were too hard to be eaten.

Mr. John Milne, writing to me from Inverurie, Aberdeenshire, on Oct. 20th, also mentioned that the larva of the Diamond-back Moth had done considerable injury to the Turnip crop in the county, and affected the weight of the crops very considerably on some fields.

On Sept. 1st and 4th Mr. H. E. Donne, writing from Court Green, Cloughton, Scarborough, mentioned that a seven-acre field of Turnips, of which he enclosed samples of leafage, was infested by two or more kinds of insects, and was beginning to turn yellow.

Much damage was done to the leaves, of which a portion consisted in the lower part of the skin being eaten away, as in the case of attack of caterpillars of the Diamond-back Moth; and my correspondent mentioned that he found the caterpillars closely resembled the drawing of that of the Diamond-back Moth which I sent him. But in this instance I found a condition which looked so like the chrysalis cocoon mouldering away, and thus natural causes preventing recurrence of attack, that it may be worth while to mention it for future investigation.

Beneath some of the leaves there were small white patches, which from their size, situation, and general shape looked like the cocoons of the Diamond back Moth; but on close examination appeared to be masses of white mould, often with brown matter in the middle. The whole mass was easily detachable from the leaf, this showing that it was not a growth from the surface. So far as I could make out, it appeared as if from some circumstances the grub or chrysalis in the cocoon had died and mouldered into a brown mass, and the white fungoid or mould growth had developed on the cocoon into the small masses, looking at a glance like the still perfect cocoon. More examination when specimens may be more numerous might give us serviceably interesting information as to one method at least of failure of autumn continuation of propagation.

The above notes give little more than report of observation of the presence of this serious Turnip pest, but are desirable to record relatively to possible reappearance in the coming season; and amongst some amount of special observation it will be seen (p. 121) that various kinds of Sea Gulls were again visible on the infested land, thus drawing

attention to the mischief that was going forward, and also helping to lessen the amount. The white bodies beneath infested Turnip leaves, having the appearance of cocoons covered with mould, and with the contents in brown decay in the centre, are also worth attention.

The habit of life of the Diamond-back is for the female moths for the most part to lay their eggs on the under side of the leafage of the attacked plants, as Turnips, Swedes, Cabbage, Charlock, or allied crop-plants, or weeds.

The caterpillars, when full-grown, are about half an inch long, and somewhat spindle-shaped, that is, taper towards each end. The colour is variable, but commonly of an apple-green, and when near full growth the head is usually grey or yellowish, and marked with small black dots, and the next ring has a number of very minute black specks. When young the caterpillar is often yellowish or greyish, with black head. Each of the first three segments bears a pair of claw feet, and there are four pairs of sucker feet beneath the body, and another pair which are set out slantingly from each other at the tail. When alarmed the caterpillar can let itself down by a thread, up which it returns again at pleasure.

Where severe attack is present, it may be distinguished from other insect mischief by many of the leaves being what is termed "lace-worked." The caterpillars feed on the under coat of the leaf, so that to a certain extent the upper coat may often be found remaining merely as a thin film. But very often, from the caterpillars not feeding on the veins of the leaves, these will be found remaining, with the thin connecting upper coat of the leaf so broken away in drying that the network of veins greatly resembles a piece of coarse pale brown lace, and the appearance may be taken as a guide to the kind of infestation that has done the mischief.

The caterpillars spin up in about four weeks from hatching, and form cocoons on the under side of the leafage of their food-plants, or in any convenient place on or near it. These cocoons are often of such a mere open network that the form of the chrysalis can be seen through the web of threads. The time spent in chrysalis state may vary a good deal, as from rather over one to about three weeks; *the chrysalids from the last brood of the year remain in this state through the winter.*

The size of the moths is only about or rather under two-thirds of an inch in the spread of the wings, and to ordinary observation they appear as brownish-grey moths, about the size of "furniture moths," but long and narrow in shape. When at rest, and the upper wings laid along the back, with the edges meeting, the pale patterns along these edges form diamond-shaped marks, whence the English name

"Diamond-back Moth"; if seen sideways, the curved-up extremity of the wings, as shown at 3 and 4 in the figure, is very striking.

Prevention and Remedies.—Such measures as were found serviceable in the great attack of 1891 were entered on fully in my Annual Report for that year, and also in my Official Report to the Royal Agricultural Society as their Consulting Entomologist; and the main points of these are embodied in a leaflet on this infestation, of which I should be happy to send copies (free) to any applicant.

But it may be noted that one important point is to keep watch for the very first appearance of attack, so as to be able at once to make requisite applications to keep up the strength of the plant under the injury.

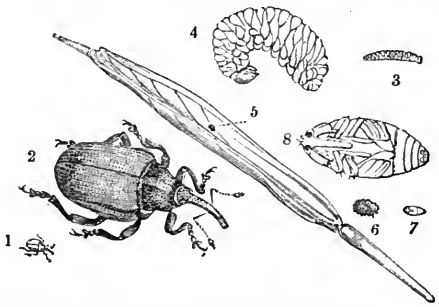
Of the various recipes sent, one that was named on trustworthy authority as answering well during bad attack of 1891 was an application of 10 cwt. soot, 8 cwt. nitrate of soda, and 1 cwt. ammonia, mixed well, and sown broadcast by hand, whilst the dew was on the leaves, at the rate of 1 cwt. per acre.

Nitrate of soda and soot mixed were mentioned as very useful, where there was rain to soak the application down; also the use of nitrate of soda at the time of singling, the worker sprinkling a little as he goes along, and so the effect being greater than in broadcasting.

Use of scufflers with boughs fastened on them to brush the caterpillars down (*which fall on alarm*) does good, but the great point is by every possible means to keep up the strength of the plant till the time of feeding of the caterpillars is past.

It is well said, when attack is about, that the caterpillars, being on the under side of the leaves, there are great difficulties in the way of getting at them by sprayings or dressings of any kind; but if we can by any means induce a growth which will counterbalance the daily ravage of the grubs, we have a good chance of carrying the crop on until the infestation lulls off in course of nature into the chrysalis state.

Turnip-seed Weevil, *Ceutorhynchus assimilis*, Payk.
Turnip and Cabbage Gnat Midge, *Cecidomyia brassicæ*, Winn.



Ceutorhynchus assimilis.—1 and 2, beetle; 3 and 4, maggot; 7 and 8, pupa (all natural size and magnified); 5, infested Turnip pod.

The following paper is inserted not so much with a view of entering on the life-history of the Turnip-seed Weevil, which has already been given, but to draw attention to some very special points of difference in the methods of the attack of the maggots of this weevil to the seed of Turnips and Swedes; and those of the maggots of the Turnip and Cabbage "Gnat Midge," the *Cecidomyia brassicæ*, which, from comparison of observations previously sent with samples of attack forwarded to me during the past two years, I conjecture at least to share the damage to unripe seed in the pods with the Turnip-seed Weevil more than is generally known of.

Taking the habits of the Gnat Midge grubs first, these are found towards the end of May and in June in the seed-pods of Turnip or other plants of allied kinds in great numbers, where they suck the juices from the seeds. These infested pods do not ripen properly; they swell at the attacked spots, become prematurely yellow, and split open, so that the mature maggots fall out and bury themselves to turn to chrysalis state in the ground. The little gnat-like flies, which are not as much as one-twelfth of an inch in length (1·25 mm.), appear in about ten days, and presumably start a new generation.

The method of attack of the maggots is similarly described by Dr. J. Ritzema Bos* in the following words:—"They suck out the juice of the unripe seed, which is thus destroyed before the time for maturity is arrived. The pods swell at the maggot-infested spots; they ripen and wither sooner than those that are healthy, and burst, and the larvæ fall to the ground, where they pupate. In about ten days swarms of little gnats make their appearance. These certainly

* 'Tierische Schädlinge und Nützlinge,' von Dr. J. Ritzema Bos. Berlin, 1891, p. 588.

again lay eggs on the pods to be found at the upper part of stems of Rape or other cruciferous plants."

Another point which is especially noticeable in the habits of these Cecid maggots is the great numbers in which they live together in the infested pods. They have been recorded by continental observers to live up to as many as from forty to sixty in one pod, and in the observations sent me in 1896 by Mr. W. Sim, of Gourdas, Fyvie, Aberdeenshire, he found as many as thirty.

For many years I have been in receipt of pods more or less distorted, and showing premature yellowing and splitting open; but it was not until 1896 and 1897 that I was able to thoroughly observe the complete difference in the method of attack of the two kinds of maggots under consideration to the seed itself.

In October, 1896, Mr. W. Sim, writing to me as above from Gourdas, in Aberdeenshire, forwarded me specimens and careful notes of the attack of the larvæ of a Cecid to Turnip seed in the pod, which agreed so thoroughly in all respects with that of the *Cecidomyia brassicæ* of Winnertz, that it appeared to be obviously of that species.* The imagines, that is, the developed Gnat Midges, being, however, dried and somewhat injured, Mr. W. Sim, on the repetition of the attack in July of the past season, sent me again a large supply of infested pods, in the hope that I might rear the Gnat Midge. I was unfortunately unsuccessful in this matter, but the pods sent me were so greatly infested not only by Gnat Midge maggots, but also by those of the Turnip-seed Weevil, that I was able to compare the method of working, and to secure a few observations of the manner in which the latter destroys the seed by straightforward consumption of the contents, which, though alluded to in some degree by entomological writers, is not, so far as I am aware, well known practically.

It was on July 5th, 1897, that Mr. Sim wrote me as follows:—

"The insect-pest which was so destructive to my Turnip-seed crop last year, and which you described and named for me *Cecidomyia brassicæ*, threatens to be even more serious this year"; and on examination I found great numbers of Cecid maggots present, some of which were then leaving the pods.

But on further examination a day or two after, I found that besides the Gnat Midge maggots there were also a number of Turnip-seed Weevil maggots present, which were busily at work destroying the seeds. One (apparently full-grown) was working with its brown head inside a seed which it had cleared out, whilst a collection of wet green rejectamenta lying at the caudal extremity showed that the work of destruction was then going on. In another pod I found a much younger weevil grub which had recently begun to attack a seed, and

* See my 'Twentieth Report on Injurious Insects,' pp. 148–152.

had only made a small progress into it with its little brown jaws. In another instance the beetle-grub had its head by the remains of the skin of a seed, and in another the larva was eating so diligently that it was not disturbed on the pod being opened; and in this instance also the maggot was lying together with the wet green rejectamenta.

When the two attacks were thus under observation together, the very distinct methods by which the seed in the pods was ruined, or the contents devoured, was very striking. In the case of the Cecid maggots their *suction* of the unripe seeds destroys them before the time of ripening, and I found many of the seeds shrunk and sunk in, especially at one part of the surface—in fact, blighted and aborted in growth; whilst in the case of the weevil maggots, I found them, as noticed above, in the act of clearing out the contents of the seeds, and so busy at their work as not always to be disturbed from it on the pod being meddled with. I also found the dividing membrane down the middle of the pod gnawed into holes, and in one pod as many as five of the still remaining seeds were gnawed by the weevil maggots.

In the account of his own observations given by John Curtis in his 'Farm Insects' (p. 105), he particularly notices this not being mere injury, but *consumption* of the seeds by the weevil maggots. He mentions:—"Three pods were forwarded to me, each being punctured, and on opening them I found only one seed untouched, and two that were but slightly eroded; others were half-consumed, and many entirely eaten up; a hard gummy substance of a dark colour enclosing the spots occupied by the maggots, which might be the dung compressed by the animal." As Curtis's specimens were obviously in a later condition than mine, it seems evident that this gummy substance was the dried state of the wet green matter which I noticed was being excreted where the weevil maggot was then feeding.

The maggots are of the shape figured at p. 126, fleshy, legless, much wrinkled across, and yellowish white in colour, with pale brown heads. These larvæ fall to the ground on premature opening of the infested pods, and bury themselves in the ground, where they are stated to form an earth cocoon for their change of condition, from which the little weevils may be expected to begin to appear in about three weeks.

In the case of my own specimens from pods received on July 5th, I found, on examining the collection on Aug. 3rd, that there were a good many of the little weevil beetles already developed, perhaps about six or eight, but their great activity made it difficult to take observations whilst they were alive. If allowed to pause (as on the edge of their jar) they would without delay expand their wings and fly away, and whilst in captivity would run, if undisturbed, with great nimbleness, or, if disturbed, would immediately drop down.

The weevils are not quite the sixth of an inch long, including the proboscis (see figure, p. 126). The colour is black when the specimens are old or have been rubbed, but when freshly developed the coating of fine white or greyish hairs gives them a grey appearance. There may be two broods during the season. The last lives through the winter, and when the beetles come out they feed on the flowering shoots of Turnip, Mustard, or allied plants, and Rape is especially recorded by continental observers as being attacked.

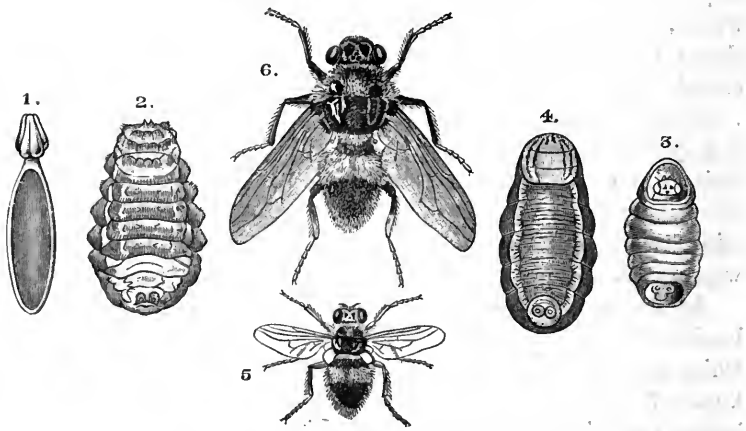
Consequently on its various methods of injuriousness, this weevil is only too well known as one of our regular crop pests; and in 1891, which was one of the years in which it was specially observed in company with the Turnip-flower Beetle, the mischief caused by the joint attacks near Kelvedon, in Essex, and Cardington, Bedfordshire, was severe.

In that year Mr. John Moss and Mr. Geo. Malden (of the above localities) were good enough to place in my hands notes of treatment which to some degree lessened the amount of mischief from these two kinds of beetle infestations, and which are given, with details of the habits, and likewise figures of both kinds, in my Annual Report for that year.

But the *Cecidomyia* attack appears to be confined to *suction* of the unripe seeds, and if some of my correspondents in the coming season should be kindly disposed to send me some specimens of prematurely ripening Turnip pods, I think it might be of serviceable interest to find whether this little Gnat Midge attack is not more generally distributed than is at present known of.

OX WARBLE FLY, OR BOT FLY,

Hypoderma bovis, De Geer.



1, egg; 2, maggot; 3 and 4, chrysalis-case; 5 and 6, fly. 3 and 5, natural size, after Bracy Clark; the other figures after Brauer, and all magnified.

During the past season much application has been made to myself regarding warble prevention. I have received from upwards of two hundred and fifty to three hundred letters on the subject, these including many applications for copies of my four-page leaflet on Warble, with requests sometimes for one copy, but in a large proportion for numbers for distribution, up to as many as a thousand. I have also distributed, approximately, a thousand copies of my 62 pp. abstract of information from my previous reports on Warble Fly, and have had great pleasure in copies of this being accepted for distribution to the students at the Royal Veterinary College, the Royal Agricultural College, and other important centres of special work.

The only additional recipe for destroying maggots in the warbles which has been brought forward (so far as I am aware) besides those which we—that is, those practically concerned in warble prevention—have known now for fourteen years as answering well for the purposes required, is the application of dry salt by rubbing it into the openings of the warble swellings. From the report of the Technical Instruction Committee of the Staffordshire County Council, bearing date August 14th, I gather that the experimental application was only tried on an exceedingly small scale; but doubtless, as well as the long known treatment of dressing with brine, might prove serviceable.

Also, consequently on the careful attention which I have endeavoured to give the subject of warble prevention since 1884, application

has been made to me from various quarters that I would come forward *publicly* as advocating it being made compulsory that all owners of warbled cattle shall dress the warbles in some satisfactory manner during the spring, and that the police should see the order carried out.

In regard to writing to the Press on this subject, I should consider (as I do not hold any official position) that I should be taking a very great liberty in endeavouring thus to bring action to bear as requested on the Board of Agriculture, more especially as I gather from Press notices that the Board of Agriculture has been applied to and declined to act.

But in my own publications the case is different, and here I hope I am not presuming in saying that, though we all are perfectly aware that far more action is needed than is as yet taken by a large proportion of farmers with regard to destruction of warbles at the season when they are most prevalent, and also in application of preventive dressings in summer, I have no hesitation in stating that I believe it is demonstrable, from both farming and statistical records and entomological data, that the practical extinction of the Warble Fly in this country, in which it has long been thoroughly established, by any measures whatsoever, is NOT *within the bounds of possibility*.

So fully do I believe this that, so far from desiring to aid in petitioning for compulsory measures, I should think myself much more justifiable in suggesting to all owners of cattle that they should be on the alert, and, if it came to such a point, that they should earnestly petition that they should be left undisturbed by compulsory interference with their property.

In regard to data on which opinion can be formed on this matter, it appears to me to rest much on knowledge of two leading points :—

1. How far warble maggot is to be found present *throughout the year*. This is of vital importance in the consideration.

2. Where the plan of destruction of maggots in the spring has been carried out as we have trustworthy record of it having been done regularly for thirteen years in one district, what has been the result?

Once again I beg most respectfully to submit that I only give my own views consequently on having been so repeatedly pressed regarding the matter; but I lay the following notes from information in my possession before my readers that they may judge for themselves how the matter stands.

The first portion of the subject entered on, it will be seen, is the condition of the warble maggot during the year in connection with the cattle; next, some market reports showing date of presence in hides; and thirdly, extracts from communications given me (duly

acknowledged in all cases) regarding amount of warble injury, from which I have now chiefly taken the dates of presence.

The following notes give observation of dates of first appearance of warble maggot in condition large enough to be perceptible to the naked eye; also dates of first general appearance of the warble as a swelling or opening; and also of the time when the maggots were noticed to be leaving the animals during the months of 1884 and 1885 in which information was sent me, from which I formed my first report on Warble Fly. I give the dates of the months only, the year being less important.

On November 8th a piece of infested hide was sent me by Messrs. C. and H. Hatton, Barton Tannery, Hereford, as showing first symptoms of presence of warble maggot. This piece of hide was about 12 in. by 4 in., and on the *flesh side* there were upwards of seven slight swellings about a quarter of an inch across, of a livid or bluish colour, each forming a raised centre to greatly-inflamed patches. Within the blue centre I found a small warble maggot, just large enough to be distinguished by the naked eye when removed. This is the earliest state in which I have had the opportunity of seeing the maggot-workings beneath the hide.

On January 27th Mr. John Dalton (tanner), Wigton, Cumberland, wrote:—"I have to-day noticed, for the first time this season, the appearance of the young warbles. I found them in two different hides (both off young cattle of from one to two years old). . . . *The round hole in the hide is distinctly visible.*"

The first reports of observation of *general* appearance of the warble as a swelling or in open condition began at the middle of February; on the 14th (from Glendonagh, Midleton, Co. Cork) the lumps were reported as increasing in number and size; and on the same day examination of the cattle at Spurstow Hall, Tarporley, Cheshire, showed that some of the warbles appeared as soft lumps gathering to a head.

On the 18th Messrs. Hatton (tanners), of Hereford, wrote me that they had received an Ox hide with many warbles in it (specimens of which were forwarded), by presence of which the value of the hide was deteriorated in value from 35s. 5d. to 29s.; and on the previous day Messrs. Hatton had informed me that "notice had already been given that hides on Birmingham Market would be sorted for warbles, and those having more than three would be out-classed."

On the 20th I had the opportunity of examining warble myself in young but open state in the hide of a Hereford removed that day from the animal.

On the 23rd, report from Ballinacourte, Tipperary, Ireland, noted that warble had appeared on some of the cattle.

On the 25th, Mr. Thompson, M.R.C.V.S., Aspatria, Cumberland, wrote me that he had examined a large number of young cattle rising

two years old, and found them well covered with the warbles in various stages, "some of them have twenty enlargements on the back, all showing the external opening."

Mr. H. C. Haines (tanner), Newport, Mon., wrote me:—"I seldom see much of the warble in the pelts excepting during March, April, and May. . . . I usually commence to notice them as April comes in; for about a month I should judge fifty per cent. were damaged."

In regard to dates up to which warble maggot was still present on infested animals, also date of escape of the maggots at the end of what may be called the ordinary maggot season, Mr. Hy. Thompson wrote me from Aspatria on May 15th:—"I examined a byre yesterday near the sea, and failed to find a single warble. Next place I went to the cattle's backs were nearly covered. The grubs are leaving the animals very fast now in this district."

On July 9th following, Mr. John Dalton (tanner), of Wigton, Cumberland, wrote:—"At the present time hides are almost free from warbles, the worm having in almost every instance escaped. The last three weeks is the period (this year and in this part of the country) when the creature has made its exit."

The above notes of observation of presence of the infestation show the maggot (with the guide to its presence of the inflammation caused by it in the under surface of the hide) to be large enough to be noticeable in November, and the external swelling of the warble, in some instances already open in the centre, to be noticeable in January; general appearance of warbles to begin about the middle of February; attack to continue during March, April, and May; maggots noticed to be leaving the cattle about the 15th of May, but still so far present later on that the three weeks preceding the 9th of July is noted as the chief time (in the observations then being taken) during which the maggot had made its exit.

These dates may be considered as showing the general range of period of warble presence, irrespective of presence of egg or maggot in its very earliest condition, which dates necessarily from the time of the Warble Fly laying its eggs, popularly "striking" the cattle, which is variable; and also of casual presence between the middle of July and the commencement of observable development of the new attack of warbles in autumn or early winter, of which I had very complete specimens, including passage through the hide, in November.

The two following tables, and the remarks accompanying, give information regarding a portion of the period—in one case of seven weeks, in the other of thirty-two weeks—in which warble attack was found present to such amount on hides as to be matter of regular business record. For this information I was indebted to the courtesy of Messrs. Fry & Co., Leather and Hide Factors, Moor St., Birmingham.

The following table, it will be seen, gives the weights of the six classes of hides reported, together with the number of sound and of warbled hides in each; also the reduction on warbled hides per pound, and per hide, and the consequent loss in each class.

Particulars of seven weeks' supply of six classes of hides, being the total of each class of sound and warbled sold at two markets in Birmingham, commencing May 3rd up to and including June 14th, 1884, and showing the actual loss of each class of warbled hide:—

Six Classes of Hides. Weight from	Hides. No. of sound.	No. of warbled.	Sold at	Per Hide less than the sound.	Loss on each Class. £	s.	d.
95 lb. and upwards	286	67	¾d. per lb.	or 6s. 3d. per hide	20	18	0
85 lb. to 94 lb.	446	222	⅞d. ,,	,, 6s. 7d. ,,	73	1	6
75 ,, 84 ,, ...	754	373	1d. ,,	,, 6s. 8d. ,,	124	6	8
65 ,, 74 ,, ...	881	579	1d. ,,	,, 5s. 10d. ,,	168	17	6
56 ,, 64 ,, ...	629	441	1d. ,,	,, 5s. 0d. ,,	110	5	0
55 lb. and under ...	283	224	1d. ,,	,, 4s. 3d. ,,	47	12	0
Totals.....	3279	1906		Total.....	545	0	8

The reader's attention is particularly directed to the proportion of warbled hides, which amounts to nearly two-thirds of the number of sound hides, showing the great prevalence of warble maggot still remaining during the seven weeks, inclusive, from May 3rd to June 14th.

The following table is an abstract of particulars of sound and warbled hides sold at one of the three Birmingham markets from February 14th to September 19th, 1885. The detailed information which I have given in full in my Annual Report for 1888 and elsewhere contains in column form returns for each week of the period named of amount of sound and of warbled hides sold in each of the classes named, with price of each.

Abstract of table, with particulars of eight different classes of hides sold during warbled season of thirty-two weeks from February 14th to September 19th, 1885.

Weight and Description of Classes of Hides.	No. of Sound Hides.	Highest and Lowest Prices per lb.	No. of Warbled Hides.	Highest and Lowest Prices per lb.
95 lb. and upwards	621	5d. to 6d.	68	4½d. to 5½d.
85 lb. to 94 lb. ...	911	4¾d. ,, 5⅜d.	138	4⅜d. ,, 4⅞d.
75 ,, 84 ,, ...	1495	4½d. ,, 5⅜d.	306	4d. ,, 4⅜d.
65 ,, 74 ,, ...	1789	4d. ,, 4⅞d.	541	3⅝d. ,, 4⅛d.
56 ,, 64 ,, ...	1692	3⅞d. ,, 4⅞d.	497	3½d. ,, 4⅛d.
55 lb. and under ...	873	3¾d. ,, 4¾d.	305	3½d. ,, 4⅛d.
Heavy cow-hides ...	1193	3⅞d. ,, 4¾d.	140	3½d. ,, 4d.
Light cow-hides ...	1382	3⅞d. ,, 4⅝d.	151	3½d. ,, 3⅞d.
Totals ...	9956		2146	

Careful study of the detailed (folding) tables, from which the above is abridged, is well worth while for those practically interested. They show the different time over which attack extends from February 14th, and that it certainly cannot be considered as stopping in July. We find it in the three lighter classes of hides *as still present on Sept. 19th*, but it is worth some notice that three heavy classes did not contain warbled hides at a much earlier date. The heaviest ox-hides, 95 lb. and upwards, were free after May 30th, and the two others of these heavy classes were free (save two hides in one class and one in the other) respectively after June 27th and July 18th.

To the above I add some short notes of duration of warble from information given me by the secretaries or managers of various of our hide or butchers' societies or companies specified.

"We should say that during the months of March to August inclusive there will be fully 60 per cent. of the hides more or less affected, with an estimated loss of 2s. 6d. per hide average."—James Watson & Sons, Hide Market, Whitehall Road, Leeds.

"Warbles begin to show in March and continue until October."—W. B. Welbourn, Secretary, Nottingham Hide, Skin and Fat Market Company, Limited.

"We reckon the warbled hides to be—in the month of February, 20 per cent.; in March, 45 per cent.; in April, 30 per cent.; and in May, 20 per cent."—Messrs. Whinyates, Webster, McNaught & Co., Hide, Skin and Fat Brokers, The Market, Gill Street, Liverpool.

"The Bristol slaughter of beasts would be about 700 per week, and during the summer and autumn months fully one-third of this number would be warbled."—William Willis, Bristol and Western Counties Butchers' Hide and Skin Co., Limited, 88, Thomas Street, Bristol.

"I have no means of ascertaining definitely, and can only approximate the following results:—The hides suffer most severely from March to the end of August in each year; they are slightly damaged during the months of February, September, and October; whilst during the other three months of the year they show slight traces, after tanning, by the marks left after the warble holes have closed up. Taking our supply of 50,000 hides (excluding odd numbers) sold during 1888, the amount of damage on the following basis would run thus:—

	£	s.	d.
2*s.* 6*d.* per hide on 9000 hides, being one-third received from March 1st to August 31st	1125	0	0
1*s.* 6*d.* per hide on 2500 hides, being one-fourth received during February, September, and October	187	10	0
9*d.* per hide on 3000 hides, being one-fourth received during November, December, and January	112	10	0
Total	1425	0	0

"Adopting another basis of calculation, taking the average to be 25 per cent. from March 1st to October 31st, and 12½ per cent. for the remaining portion of the year, and taking the damage at an average of 2*s*. 6*d*. per hide, the result would be £1250.

"I am inclined to think that both these estimates considerably under-rate the mischief done, and would especially point out that these figures refer only to the deterioration to the sale of the hides in a green state, and do not take into account the loss to the tanner on the finished article being depreciated in value, or the cost of labour and materials expended in producing leather which when finished is found to be unfit for the purpose intended."—W. H. Hill, Manager to the Sheffield Butchers' Hide and Skin Co., Limited.

"In our market we have a system of inspection for all market hides, being hides of cattle slaughtered in Glasgow and neighbourhood for food purposes only. Under this system the hides are classified,—first and second classes, the latter being faulty flayed and warbled hides.

"Taking the warble months as February to May inclusive, we find the proportion of second class to be 56 per cent., while from June to December the proportion is only about 36 per cent., being, on a fair calculation, an increase of 20 per cent. on account of warbles."—Messrs. Robert Ramsey & Co., Auction Brokers, Hides, &c., Greendyke Street, Glasgow, N.B.

A summary of the above observations and estimates shows warble maggot to be *customarily* present present from February to the beginning or middle of June; and (during the remainder of the year) records are given of the attack as lasting until August; also as continuing until October; also that during the summer and autumn months one-third of the beasts slaughtered (locality named) are warbled; and in another trade report 20 per cent. is named as, on a fair calculation, the amount of warbled hides of cattle slaughtered for food purposes in the period from June to December.

The time of flight of the fly is given by Dr. Brauer as June to September*; this, as the duration of the chrysalis state is from twenty-six to thirty days or a very few days longer if low temperature is unfavourable to development, shows normal continuance of the pest in larval state for many weeks beyond what is conveyed by the word "spring."

Under the present cattle regulations there is probably little danger of spread of infestation from foreign cattle, but just to gtve a single reference as to warble *presence:* in 1887, Mr. Jos. G. Angus (a member of the Newcastle-on-Tyne Hide Inspection Society) wrote me:—"Of the thousands of live cattle brought to the Tyne yearly

* 'Monographie der Œstriden,' von Friedrich Brauer, Wien, p. 127.

from abroad, a very large proportion are badly warbled. There is also great difficulty at times by introduction of warble on Irish cattle into farmsteads, where the greatest care is being exercised to keep the cattle free of infestation." I have once myself had imported American warble sent me. This kind—the *Hypoderma lineata*—has long been known to be in Britain, and the infestation may be found together with that of the maggots of our own kind—the *Hypoderma bovis*—even on the same beasts; but I am not aware of anything that can be considered prevalence of this species.*

From the collective testimony given above, it seems to me to be *proved* that a spring clearing cannot be looked to as a means of "stamping out" warble; but at the same time there is no doubt, that is to say, we hold the proofs in our hand from twelve years' minutely recorded work over a large district, that very great benefit is caused where the spring destruction of the maggots is *properly* carried out.

We have plenty of trustworthy records of benefit from squeezing out or otherwise destroying the maggots, and also of benefit of prevention of attack by use of washes or dressings to keep the fly from egg-laying in summer; but I am not aware of our possessing any other record than that given below of the work being carried on persistently in the spring season of twelve successive years, that is, from 1885 to the spring of 1897 inclusive, and on an area where, taking the table for 1888 as an example, the cattle on the twenty-three steadings under operation, besides the few animals of cottage owners, included three herds of 25 to 27 cows; four herds of 32 to 40 cattle; one of 50, and one of 56; and four others respectively of 57, 72, 79, and 86 animals, chiefly cows, but with a small proportion of heifers and calves.

The work was begun in the year 1885 by Mr. W. Bailey, headmaster of the Aldersey Grammar School, at Bunbury, Tarporley,

* For much that is of interest regarding the warble of North America, see "The Ox Bot in the United States; Habits and Natural History of *Hypoderma lineata*," by C. V. Riley; 'Insect Life' (United States Department of Agriculture), vol. iv. pp. 302–317. From these observations it appears that the American Ox Warble is a distinct species to ours, which is stated in this paper (published in 1892), so far as was then known, not to occur in North America. The American writer considers there is a very important difference in early habits; the larva of their species commencing its progress from the gullet, and thence penetrating through the tissues, until after eight or nine months of this existence it reaches the back, and penetrates the skin, and forms a warble swelling, as is the case with our kind, the *H. bovis*. We have the *H. lineata* in this country, but with my best endeavours I have never been able to get specimens showing the attack in the œsophagus, or the larvæ in transit. For details of differences observable on careful investigation between these two species of flies, and also the differences between their larvæ, the reader is referred to the above paper, which is very fully illustrated.

Cheshire (where the greater part of the pupils are the sons of farmers), showing the boys samples of the warble maggots, telling them the history of the infestation, and begging them to bring what they could find. At that time the warbles were enormously prevalent in the district, and the result was that one pupil alone brought in 250 maggots. The next year's work showed a reduction in the numbers to be found, and the next four years the returns stood as follows :—

1887.	March	28th.—Number of stock examined			293;	warbles found	109.
1888.	,,	20th.	,,	,,	515;	,,	341.
1889.	May	29th.	,,	,,	577;	,,	1077.
1890.	,,	21st.	,,	,,	675;	,,	827.

In 1891 few warbles were found, the largest number brought in by any one boy being 23 ; and the continuance of the plan year by year reduced the number of the pests to what was practically of little importance, and the work is still continued and reported to me, with information accompanying why there should sometimes be a rise in the number of maggots collected, which was the case in the spring of 1897, consequently on some of the boys being enabled to go beyond the district under previous care.

This work was done with full approbation of the farmers, and was considered so satisfactory that an account of what was being carried on, written by Mr. Bailey to His Grace the Duke of Westminster as one of the great landowners of the district, was read by the Hon. Cecil Parker, in 1887, before one of the Committees of the Royal Agricultural Society, and was recommended for publication.

The above notes show the great success of the continued attention to removal of the maggots, but also that with every circumstance in favour of this success, still the pest was not stamped out.

The work was done by the boys who were accustomed to be with cattle, and more or less well known personally to the herds amongst which they searched out the warbles, which is an important matter. Also there was a great incentive in a mark being given for each maggot, which counted for something towards a few prizes which were yearly given to the most successful collectors.

But the specially important point which was met in this treatment was that the search went on *constantly* up to a certain date. The warble maggot matures very rapidly towards the completion of its growth, and whilst on the one hand (under the system of compulsory inspection) the presence of warbles may be made a cause of great annoyance to an owner whose beasts have been cleared only a few days before, on the other, an unskilled "policeman" will probably overlook many which would shortly be what is called "ripe."

The time requisite for inspection would be something enormous,

and also, though in the following point a veterinary opinion would be needed if the difficulty I believe would occur, *does* exist, I should conjecture that the frequent annoyance to the cows caused by presence of complete strangers disturbing the quiet of the herds and frightening the individual animals by handling and turning up the hair in the search for neglected warbles would be likely to be seriously prejudicial to their health, even if the "policeman" was accompanied by the herdsman. If he has free access without, the results might cause much greater loss from terrification of the breeding stock than any moderate amount of warbles; and, as I have been so repeatedly written to in the past few months to request me to give my views on compulsory prevention, I trust, in laying the above points before my readers, that I am not intruding beyond what I may with all due deference submit to them, more especially because, as previously mentioned, I believe that the Board of Agriculture has been referred to, and replied that it was considered undesirable to move in the matter.

It lies in the cattle-owners' hands to clear their beasts so as to make an enormous reduction in the amount of warbles; the simple methods by which this can be done have long been before the public, but there is a great need that this information should be more disseminated; and it is eminently to be wished that more care should be taken as to *the authority* on which recipes and directions for dressings are brought forward.

There is advice abroad—as, for instance, that of a general smear of the hide to kill the maggots in the warbles—which is *worse* than useless, for, while it does no good in itself (as to kill the maggot the application must be thoroughly placed so as to choke the breathing-pores or poison the grub in each warble), it stands in the way of proper applications. Also there is advice good in itself, but that would be much more serviceable if the name of a well-known adviser was appended.

At p. 747 of the fourth part of the Journal of the Royal Agricultural Society of England for 1897 is an excellent recipe for a smear for prevention of attack of the Warble Fly, with the remark prefixed,—"In the Proceedings of the Council of July 31st, 1895, the Society gave the following directions for the prevention of warble attack." But to many of us it would have strengthened the advice if the recipe had been acknowledged to its original contributor, the well-known veterinary surgeon Mr. Henry Thompson, M.R.C.V.S., Aspatria, Cumberland, by whose permission I printed it as follows in my Annual Report for 1884, with his name appended, and we have thus (from my contributors) knowledge of success of the treatment on thirteen to fourteen years' evidence :—

"I have used and also recommend the following mixtures as a preventive:—Flour of sulphur, 4 oz.; spirits of tar, 1 gill; train (whale) oil, 1 quart. Mix well together, and apply along the spine of the cow once a week with a small brush. The smell drives off the flies, and prevents them depositing their eggs, and the cattle are left *at peace* to graze, and warbles thus prevented."—Henry Thompson, Aspatria.

In the whole course of my reports of warble prevention I have named the authorities to whom I was indebted, and thus they give (*verbatim*), to save danger of mis-statement, the views of known writers,—on the more especially veterinary points, for instance, as of Dr. George Fleming, C.B., Prof. Penberthy, President of the Royal Veterinary College, Mr. Henry Thompson, M.R.C.V.S., &c.; on treatment, the contributions will be found there of Mr. Stratton, Mr. Duckham, Mr. Farrell (on success of treatment of two hundred and fifty of his herd of eight hundred head of cattle), and of others, in scores or rather perhaps in hundreds of many of whom the names are well-known to all conversant with cattle treatment.

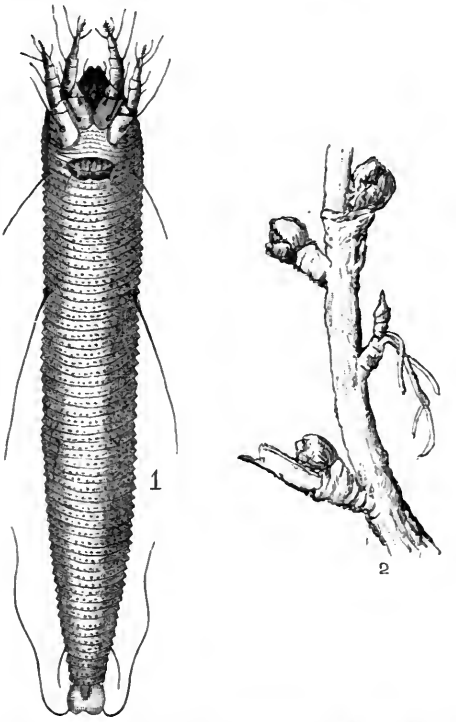
I take no credit to myself for the work beyond careful presentation of the views intrusted to me for the public use; but I certainly think that it is right to note for the benefit of those concerned that those records of almost every imaginable detail of life-history and preventive measures against this pest *do exist and are procurable.*

And in regard to distribution, I should be only happy to distribute the remainder of my 62-page abstract of information gratuitously to all applicants so long as I still have copies, and also to continue distribution of my leaflet—which has now reached the hundred and fifty-first thousand—gratuitously in any numbers desired.

APPENDIX.

BLACK CURRANT.

Currant Gall Mite. *Phytoptus ribis*, Nalepa.



PHYTOPTUS RIBIS, greatly magnified; natural length of female 0·23 mm. (by permission, after Dr. A. Nalepa). Black Currant twig with Mite Galls.

For many years the Currant Gall Mite infestation to Black Currants has been a trouble to Black Currant growers, but its steadily increasing prevalence and the failure of the remedial measures which have been hitherto tried to do more than lessen the evil are making the matter one for very serious consideration.

The mischief is caused by an exceedingly minute Mite, too small to be seen by the naked eye,—scientifically the *Phytoptus ribis*,—which lives and propagates in the buds, and causes an unnaturally large

development of these into spherical or somewhat oval soft green knobs, formed outside of greenish scales or abortive leaves folding over each other, and inside of the various parts which would gradually have developed into leaves, flowers, and fruit, in contorted and unnatural condition, and abortive for any useful purpose.

These "knobs" may be found forming during the winter whilst the healthy buds are still of their natural shape, and in January may be found up to as much as a quarter of an inch in diameter, and containing within them numbers of the Mites and some eggs. Later on, growth of the gall knobs continues until they may at times be found as large as some specimens sent me from Toddington during the past season, which proved to be for the most part from about three to four-eighths of an inch in diameter, and, in the case of the upper specimens, were dying and drying off into the condition in which the Mites leave them and emigrate to set up attack in the still embryo buds in the axils of the leaves.

Much consideration has been given to the subject by various of our leading experts on Currant growing, and various experiments are being set on foot, and especially on the Experimental Fruit Farm of the Duke of Bedford near Woburn, Bedfordshire, which it is hoped may throw some light on how to mitigate the great and the increasing loss. But the history of the infestation not being as fully before the public as seems desirable, I have endeavoured in the following pages to give some information on,—firstly, the records we have of the first observation of the pest in this country; secondly, its life-history; thirdly, observations of presence in different parts of the country, together with notes of various kinds of treatment which, even where temporarily successful, have not answered permanently in getting rid of the attack; and fourthly, considerations as to improved methods of growing, and also notes of experimental treatment which it is proposed to carry out under careful supervision at the Duke of Bedford's Fruit Farm, Ridgmont, Aspley Guise, Bedfordshire, and which I am kindly favoured by permission to insert.

First observations of the Black Currant Bud Gall infestation in this country.—The first definite allusion to the presence of this Black Currant bud disease being observed in England took place (so far as I am aware) at the meeting of the Scientific Committee of the Royal Horticultural Society on March 2nd, 1869. Prof. M. J. Berkeley then called attention to some buds of the Black Currant, sent from Bedale, Yorkshire, which were curiously deformed (similarly, it is noted, to some specimens previously described by Prof. Berkeley in the 'Gardeners' Chronicle' for 1864, p. 363). Prof. Westwood, on examining the buds, gave it as his opinion that the growth in question was due to the attack of a peculiar species of *Acarus* differing considerably

from other species in its tapering form, and in it having four legs instead of six.*

A few days later on Prof. Berkeley reported that he had since the above notice was written received an abundant supply of fresh specimens in such a state as to enable him to study the matter satisfactorily. He observed that he had no difficulty in finding the little *Acari*, though they were exceedingly minute, for they were in such abundance as to present the appearance of a thin coating of white powder; and the little worm-like creatures, when examined under a high magnifying power, were found to be accompanied by eggs. The smallest specimens of the *Acari* were noted as about 1-250th of an inch in length, whilst the largest scarcely exceeded 1-140th. The abdomen was closely striated with granular lines, and furnished with two setæ at the extremity, and one on each side; the legs were four in number, and there were a pair of palpi. The eggs were mostly obovate or broadly elliptic, and about 1-500th of an inch in diameter.

The disease was stated to have been first observed by Prof. Berkeley's correspondent in Yorkshire about four years previously, and to have increased rapidly, "and seems likely to make the cultivation of the Black Currant very precarious." †

At p. 841 of the volume of the 'Gardeners' Chronicle' referred to below are some more detailed observations of the characteristics of the Mite, which is noted as white, fleshy, and covered with minute points closely arranged in very numerous transverse rows, forming striæ of granular lines, and the body is terminated on either side by a long bristle. The general form long, convex, and tapering to the extremity of the body, with the anterior portion of the body more conical, the dimensions averaging 1-200th of an inch in length, and 1-500th of an inch in width. A figure given accompanying is so far of value that it shows the transverse striæ, and the legs being four in number, otherwise it is not a satisfactory delineation.

The circumstance is mentioned by Prof. Westwood of a correspondent sending specimens of infested Currant buds from Blantyre, N.B., in the beginning of July, stating that the disease was quite general in that district, and had been known for twenty years, and that after a plant is infested very little fruit is to be obtained from it, and that the writer had examined the buds even during the period of frost and snow, and had then observed the young animals hatching from their eggs.‡ The study of this branch of the *Acarina* being then in its infancy, there was much speculation as to the precise nature of the

* See report in 'Gardeners' Chronicle' for 1869, p. 252.

† 'Gardeners' Chronicle' for 1869, p. 276.

‡ 'Gardeners' Chronicle,' *loc. cit.*

infestation, but the above observations, given as definite statements, agree with what subsequent investigation has proved to be correct. We thus carry back knowledge of presence of the disease to 1869, and report of its presence by an observer well acquainted with it to twenty years before, namely, to 1849.

Life-history.—The family of the *Phytoptidæ*—to the genus *Phytoptus* of which the *P. ribis*, or Currant Bud Mite—belongs, is one of the divisions of the order *Acarina*, or Mites, but is distinguishable from all the other families by its more or less elongate, cylindrical, or worm-like shape, and also by only possessing four legs throughout its whole life.

The Mites of the other families of the *Acarina*—as, for instance, the Red Spider of the Hop, the *Tetranychus telarius;* the Hay Mite, *Tyroglyphus longior;* the Beetle Mite, *Oribata lapidaria*—are of a much rounder or more oval shape, but are especially distinguishable by their greater number of legs. As a rule, they possess three pairs when they are hatched and in their earliest stages, but, with subsequent moults, as they approach maturity they become possessed of four pairs.

This point of the number of legs is a very important one to observe, in order to prevent confusion in identification with other kinds of Mites which may very likely be found on Currant bushes.

The *Phytoptus ribis* is of the shape figured at p. 141, that is, long, narrow, cylindrical, somewhat tapering towards the blunt tail, at the extremity of which, on each side, is one long bristle, and there are also two other pairs of bristles one on each side of the body—one pair near the fore part, the other a little before the middle. The proboscis is short; the four legs are plainly jointed, and the abdomen with about seventy punctate transverse rings. The length of the female is 0·23 millimètre, the breadth 0·04 millimètre; the dimensions of the male are smaller.*

The infestation is to be found on the Black Currant (*Ribes nigrum*) both in Great Britain and on the Continent of Europe. Likewise occasionally on the Red Currant (*Ribes rubrum*) and the "Tasteless Mountain Currant" (*Ribes alpinum*). In regard to the infestation on the Red Currant, the only specimens I have seen were some received by me on January 15th, 1888, by favour of Dr. Friedrich Thomas, of Ohrdruf, Gotha, well known for his researches in phyto-pathology, with information accompanying that he had observed them for many years in his own garden, but that up to date of writing no notice of the attack had been practically taken in Germany.

* For practical purposes it is enough to mention that the Mites are so excessively small as to be indistinguishable to the naked eye. A millimètre is the 25th part of an inch, and twenty-three hundredths of this measurement—that is, somewhat less than a quarter—is scarcely perceptible except when magnified.

In regard to the *Ribes alpinum* we have no record, so far as I am aware, of the *Phytoptus* infestation having been found on this species in this country; but as the plant does occur with us, it might be worth while to make some investigation. In 'English Botany'* this species is stated to be found "in woods. Truly indigenous in the lower part of the western dales in Yorkshire, and said also to be wild in the counties of Warwick, Stafford?, Nottingham, Glamorgan, Durham, and the Lake District. It also occurs in several of the Scotch counties, but has little claim to be considered native in them." One very noticeable distinction between this and the other two kinds named is that the racemes (the bunches of fruit in popular parlance) are *upright* in the case of *R. alpinum*, whilst in the case of *R. nigrum* they are drooping, and usually, although not always, they are drooping in the case of *R. rubrum*.

The following notes give the life-history of the *Phytoptus ribis* as recorded by Mr. Robert Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, from his personal observations during the year 1893, and are of much interest for practical use as giving a fairly continuous account of the condition of this destructive Currant bud attack from the beginning of the year until the middle of September. Mr. Newstead remarks:—

"During the cold month of January the Mites in the infested buds were all in the perfect condition, and although the temperature was often very low, the Mites revelled in the severest frost. . . . Frost seems to have no effect on them whatever, except to make them somewhat sluggish.

"On February 20th egg-laying commenced, and on this date I found them in hundreds in company with the adult Mites. Later (March 6th), there were thousands of young forms (nymphs), eggs, and adults.

"On April 19th many of the old and very badly infested buds of last year had opened out very considerably, but had not produced, nor did they afterwards produce, a single leaf. These and the rest of the infested buds contained a living mass of the Mites in all stages, completely covering every embryo leaf in the buds. At this date numbers of the old infested buds had already become black and dried up, due in part to the fact that the buds had been transplanted in the spring, and to the excessively dry weather. All the old buds that were examined had no living Mites in them, but the dead white desiccated bodies of thousands of Mites covered the surface of the dead leaves of the buds.

* 'English Botany,' edited by Prof. Boswell Syme, vol. iv. (3rd edition), p. 41.

"May 19th, examined fifty of the old infested buds which were sent me by Mr. Gillanders from High Legh, which were taken from bushes that had not been transplanted in spring. Ninety per cent. of these buds were dead and dry—a few only having their basal portions with any life in them. In these there were many dead Mites, which had undoubtedly died a few hours previous to my receiving them, as they still contained their colour and outline intact. Those buds that were quite dead and dry gave the same results as previously stated,—*e.g.* they were covered with the desiccated bodies of the Mites, and not a living example was found amongst them. Strange to say, I failed to find a single living Mite either on the bark at the base of the leaf-stalks or in the newly-formed buds.

"My next examination was on June 2nd. At this time the newly-formed shoots had begun to harden, and the new buds on the first half of them had attained a length of 2½–3 mm., very small, but just protruding behind the leaf-stalk. Between the base of the leaf-stalk and the buds, at the ends of the young shoots, I found both adults and nymphs, but no eggs; although these latter were not found in the situations indicated, they must have been laid there, or the nymphs would not have been present.

"I carefully examined a number of young buds, but found no Mites in them. It is curious to note that the Mites occurred near the terminal buds only; this will account for such *buds* on an infested bush being most severely attacked. At this date (June 2nd) I could only find one of the old infested buds in a living condition, and this simply swarmed with adult Mites.

"On July 17th I again found the Mites located between the leaf-stalks and the buds, and with them many eggs; while ten days later (July 27th) newly-formed buds, still small, were present, but terminal ones were already showing signs of being infested. On examination these were found to contain adults, nymphs, and eggs, nearly all of which were located in the centre of the buds. This was the first occasion I found the Mites within the newly-formed buds. The old infested buds at this date were everyone of them dried up.

"During the month of August I was unfortunately away from home, and was not able to resume my investigations until Sept. 13th. At this date the new buds showed decided signs of being infested; they were much swollen, and measured 2½ to 3 lines in length, and contained the pest in all its stages. I could not, however, find any of the Mites behind the leaf-stalks as previously, so that I concluded they had taken up their winter quarters for good, and had set to work in earnest to ruin the crop of fruit while yet in the bud."

To the above observations Mr. Newstead appends the following summary. (2) is omitted as not of practical bearing:—

"(1). There were a succession of broods produced during the months of February to September. Egg-laying taking place in March, April, June, July, and September, which was therefore very probably carried on throughout the whole season.

"(3). That the Mites first established themselves between the base of the leaf-stalk and the young buds early in June (June 2nd), but were not found actually inside them until July 27th.

"(4). That so long as any life remained in the old buds swarms of the Mites were found in them; as the buds died numbers of the Mites disappeared, either dying a natural death, or being destroyed by predaceous insects. Of course, as I have already stated, some of them did certainly migrate and set up fresh colonies."—(R. N.)*

It is a pity that this useful little pamphlet is not more generally known of, as the information contained in it as to the dates of egg-laying, migration, and other particulars are precisely what are needed for a basis of attempts at least towards serviceable preventive measures.

During the present month,—that is to say, January of 1898,—as it occurred to me that in this more southerly locality than Cheshire, where Mr. Newstead's observations were made, and also, in the circumstances of the unusually mild weather of the winter up to date, it would be of interest to find whether the egg of the *Phytoptus* was present within the galls, as well as the Mites themselves, and on opening various Black Currant galls on January 25th and 28th, which I was favoured with, at my request, from the Woburn Fruit Farm, Ridgmont, Bedfordshire, I found a few eggs present.

These were oval or ovate when in characteristic condition, but sometimes irregular in outline, apparently from being pushed out of shape by the developing Mite within; but I was not fortunate enough to find a specimen in the very act of developing, as I have seen in the case of the *Phytoptus* of the Birch knots.

From my own Currant plants being clean, I have not had the opportunity of watching progress of the infestation myself; but on one occasion in specimens sent me on the 4th of April from Hanbury, near Droitwich, I found the minute white eggs in various stages of development; some still round or roundish, and others pushed out of shape at one end by the pressure on the thin egg pellicle of the bluntly-pointed head of the Mite within, the locality of the legs of the Mite being also indicated by little knobs, showing the position within of what might be called the shoulders.

* "Recent Investigations of the Currant Bud Mite (*Phytoptus ribis*)," by R. Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, Lecturer on Economic Entomology for the Cheshire County Council, pp. 5–7. Reprinted from 'The British Naturalist' for June, 1894. Price 3d.

In the case of the specimens from Woburn, I was particularly struck with the large size of the egg in comparison with the Mite, and turning to the observations of Dr. A. Nalepa on this subject, I find that he notices that "the eggs" [of the Gall Mites] "are relatively to the minuteness of the creatures of considerable size. . . . The egg-shell is thin, flexible, and formed of chitin." The author also remarks:—"In the latter part of summer and in autumn the Mites leave the galls in multitudes to take possession of their winter quarters—that is, the buds. This emigration also is of frequent occurrence during summer when the previously inhabited buds dry up."*

The preceding notes give, I think, a fairly complete summary of the history and also of the life-history of this infestation up to the present date. The following observations refer to various methods of treatment by which it has been endeavoured to check the mischief caused by this attack, some of which have appeared to be beneficial for a time; but none of which, so far as I am aware, have proved permanently reliable.

The first notes that were sent me of injury from Currant Mite were forwarded in the year 1885, when on March 25th the bud galls were already causing much injury on the specimens sent me; and later on specimens were sent me from the neighbourhood of Cottenham, Cambridgeshire, by Mr. Arthur Bull, with the information that about half an acre was affected, and that he was using "a dressing of two parts sulphur and three parts lime boiled together in water (2 lb. sulphur and 3 lb. lime, 3 gallons of water), which is further diluted at the rate of two or three pints to a large pail of water, applied with a syringe to the infested bushes." The effect of this application was that little or no damage was done, but the remark was made that "it seems difficult to clear the garden altogether."

In 1887 the infestation was reported as seriously troublesome in various localities, amongst these Clydesdale being especially mentioned; and on March 15th Mr. W. James le Tall wrote me regarding it from Hackenthorpe, West Sheffield, mentioning that "If the disease once gets into a plantation of Black Currants, it passes from tree to tree till all are infested, and from being a fruitful plantation it becomes in three or four years almost fruitless. No cure is known for the disease here but destroying the infested trees. This disease I have

* 'Die Naturgeschichte der Gallmilben,' von Prof. Dr. Alfred Nalepa, pp. 15, 18. (Erganzter Sonderabdruck aus dem ix Jahrsberichte des K.K. Staats-Gymnasium in Wien iv Bezirk). For technical description of *Phytoptus ribis*, Nalepa, species of *Ribes* (Currant) infested by it, and also figures, the reader is referred to 'Beiträge zur Kenntniss der Gattungen *Phytoptus*,' by the same author. (Besonders abgedruckt aus dem lxii Bande der Denk, Mat-Naturwissenschaftlichen Classe der K. Acad. der Wissenchaften, Wien, 1895).

noticed about fifteen years, but now it is very much more prevalent, and threatens to destroy the Black Currant crop in this vicinity." Severe complaints were made from elsewhere in England and Scotland, but no remedial measures were known of.

The following year gave the same results; bad mischief, but no known means of remedy, with the information from Ohrdruf (see p. 144) that Red Currants were not exempt from the infestation; and in 1889 still no advance was made in checking the attack.

In 1891, Mr. C. D. Wise, Manager of the Toddington Fruit-grounds, Winchcombe, Gloucestershire, sent me the first observation of endeavouring to lessen amount of infestation by clearing the galled bud growths, which were in such quantities that he wrote on the 16th of April he was sorry to say the women had to pick basketfuls.

In 1892, as well as in the preceding year, I had some remarks regarding co-tenants in the galls, of various larvæ; but as it does not seem feasible to utilize the services of those which are or may be destructive to the *Phytopti*, it does not seem worth while to do more here than refer to the circumstance being entered on. But in the same year Mr. John Biggs, of Laxton, Howden, East Yorkshire, mentioned, on April 10th, some degree of success from the following treatment:—

"You will, I am sure, be interested in knowing that I have to a certain extent prevented the *Phytoptus* utterly ruining my Black Currant trees. As you suggested in a letter of last March, we syringed the bushes twice with the solution of Paris-green, which I procured from Messrs. Blundell, and gave the soil all under the bushes a good coating of caustic lime. I also gave the bushes another dressing of the Paris-green. Just when the buds appeared this spring, I had a boy gathering all the little knobs of the trees. The result has proved as satisfactory as I could expect, considering the condition of the trees last year, and I have every prospect of securing a good half crop. Our neighbours' trees in this village are utterly ruined, scarcely a leaf to be seen this year, and the trees completely covered with the infested knobs."

In this year Mr. C. D. Wise, of Toddington, wrote further with regard to effect of removal of the bud galls (mentioned above) that "they had certainly decreased the trouble by picking off the buds."

In 1893, Mr. John Speir, Newton Farm, Newton, near Glasgow, made some report of experiment begun on a few bushes in 1891, which consisted in cutting back the stems of the bushes which were very badly attacked to within two or three inches of the ground (the branches being carefully gathered and burnt). A mixture of soft-soap dissolved in hot water to which paraffin oil was added, and stirred so as to make it combine, was diluted to a safe strength with cold water,

and syringed on to the stumps of the old bushes, and on the ground about, and on the neighbouring bushes. The bushes pushed up new shoots, and at the date of Sept. 29th, 1893, Mr. Speir reported that during the spring no affected buds were noticed, either on the bushes that were cut back, or on the others surrounding them, and during the year the bushes appeared in a very favourable way of making good growth and healthy wood in the future.

In 1894 Mr. Speir reported that "the Currant bushes treated for Mite in 1891 and 1893 still keep quite free"; but the improvement, however, did not last thoroughly, for in 1897, on February 27th, Mr. Speir wrote me as follows:—"I regret to notice to-day that some bushes which I severely pruned and dressed with paraffin emulsion some years ago for the Currant Mite are again showing symptoms of the disease. Both last spring and the one before I think I wrote you stating that the treatment up to these dates seemed effective; such, however, appears now not to be the case. I am therefore inclined in future to advise no one to attempt a cure, but to pull up all infested bushes at the *first symptoms*, and also the nearest apparently healthy bush to those visibly affected."

On April 7th, in the past season, Mr. C. D. Wise (Manager of the Toddington Fruit-grounds, Winchcombe, Gloucestershire) favoured me with the following report in continuation of his previous observations on the subject of clearing infested bud galls, which, I think, completes observation of all the plans hitherto tried as remedial measures being more than palliatives of this destructive infestation.

In the following notes it will be seen we have details of the number of quarts of galled buds gathered in the years 1896 and 1897, with cost of gathering per acre; and also the absence of benefit from the outlay (see note dated December 22nd, 1897). Likewise Mr. Wise reports that no benefit was found to result from cutting the Currant bushes down to the ground, with treatment specified:—

"*Gall Mites on Black Currants.*—We have a very serious attack of Gall Mites this spring, as will be shown by the following statement:—

Field Number.		Quantity of Galled Buds picked per acre.	Cost of Picking.
1	1896	1½ quarts	3s. 6d. per acre
	1897	12 ,,	7s. 6d. ,,
2	1896	2½ ,,	4s. 6d. ,,
	1897	8 ,,	6s. 9d. ,,
3	1896	4 ,,	5s. 6d. ,,
	1897	16 ,,	10s. 10d. ,,

"Where we have picked the Gall Mites off last autumn, the attack seems to be quite as bad this spring. You will see that the cost per

acre picking off the galls comes to a very serious item, but I do not see that there is anything else we can do; if you can suggest anything we shall be very glad.

"We have in some cases cut off the trees to the ground, and the young trees when they come up are full of Gall Mites. We have syringed with Paris-green, and we have limed the stools; all this seems to have no effect in getting rid of them.

"What we want to know is more of the life-history of this pest; where does it hybernate, and what season of the year does it move from bud to bud, and when is the breeding season?"

On December 22nd, 1897, Mr. Wise wrote further:—

"*Acari.*—I am sorry to say that the Black Currant Gall Mite increases with us; the bushes this autumn are covered with galls, and it is becoming really a most serious matter to know what to do. If we could only find out a little more of the life-history of these Mites, we might be able to cope with the pest."

In the course of correspondence and of observations of this attack, it occurred to me that it might be possible that there were varieties of the *Ribes nigrum* which were less liable to attack than others, and consequently on my application on this subject to Prof. J. Jablonowski, Director of the Government Entomological Station at Budapest, Hungary, he was good enough to procure for me from the Director of the Horticultural Institute some cuttings of Black Currant, which arrived in excellent condition, and which I shared for experiment between Mr. Speir (above mentioned) and Mr. Wise, keeping two or three for myself, but which afterwards, on having the pleasure of becoming in communication with Woburn, I forwarded for trial. We shall thus learn whether my view of there being possibly "Mite-proof" varieties is well founded, though I fear it may probably be otherwise.

The following valuable notes were sent to me in reply to some of my enquiries on this subject, as well as of other possible means of lessening amount of the Black Currant *Phytoptus* injury, by Mr. Malcolm Dunn, from The Gardens, Dalkeith; and I feel much pleasure in giving his well-weighed views on the points that I submitted to him:—

. . . . "I will answer your queries about the 'Black Currant Bud Mite' in the order they come in your letter.

"1. *The kinds of Currants most liable to attack.* — So far as I have seen, or heard, the attack of the *Phytoptus* in question is confined to the one 'kind' of Currant (*Ribes nigrum*, L.) in Britain; and so far as my personal observations go, I have not noticed the insect showing a preference for any one or more of the 'varieties' of the Black Currant. It is one of the few cultivated fruits which diverges very little in its character.

"Taking the best-known variety—'Black Naples'—as the type, all the other *so-called* 'varieties' (of which Hogg describes *five* in his 'Fruit Manual,' and I grow here at the present time *over a dozen*!) are so little different in any specific and permanent character, that it is very difficult to distinguish any difference after they have been growing alongside of each other and all receiving the same treatment for a few years. Whether reputed 'seedlings' or acknowledged 'selections,' it all ends in the same thing; they are liable to revert to the type, and if the best of the garden varieties stray to hovels or waste places, they soon deteriorate into the 'Common Black Currant'—an inferior variety, but *not* proof, even in a wild state, against the attacks of the *Phytoptus*. The most vigorous variety grown (called here 'Black Prince') is quite as liable to attack as the weakest—which here is the 'Common Black.' I have grown numerous *seedling plants* of the Black Currant; but generally they are little better, in vigour and fruiting qualities, than the common variety.

"The conclusion I draw from my experience of the attacks of the *Phytoptus* on the Black Currant is, that the *mite being present*, no variety is proof against attack. The severity of the attack may vary under different conditions, and it is not at all impossible but a variety may be found which the mite will not attack; but it is not yet in cultivation, and the chances are small of its appearance. If it is not a *first-rate* variety from a gardener's point of view, it is of little consequence whether it is mite-proof or not!—and it must be *mite-proof*, or we may derive very little benefit from it.

"The variety you have got under the name of 'Bang-up' is an old variety of Black Currant, and not equal to several good strains now in cultivation. I rather think it is still grown in Clydesdale gardens, and there of course *every variety* of Black Currant *is infested by the Mite.*

"(2.) *Grafting or budding on Red Currant Stocks.* — The Black Currant does not 'take' well on the Red; but it can be done for a test; the success of which, however, is doubtful if the Mite is in the neighbourhood, and thriving!

"(3.) *Would Standards be more free from the Mites?* — Under the usual conditions, I am afraid they would not. I will explain the reason later on.

"(4.) *Syringing, or Spraying the bushes with a liquid insecticide as a remedy.*—When done *thoroughly*, and at the *right time*, it is the best check against the spread of the Mite that we possess; but when large quantities in private or market gardens are infested with Mites, a dozen of which can safely hide in a very small cranny of overhanging bark, and remain perfectly secure from any sprayed insecticide, the chances of extirpating them are not great!

"Dusting with a powder insecticide is less efficacious, because it

does not find its way into so many of the crevices of the bark as a *hard driven spray* will do. The whole difficulty lies in the habits of the Mites securing shelter to them from all practicable remedy *outwardly applied.*

"*Steady and continuous spraying daily,* while the Mites are on the move from the old buds to new ones in the early summer, would go a long way to free badly-infested bushes from Mites; but it would require yearly attention, and I am doubtful, with an easily grown crop like Black Currants, if it is *worth the cost.* In these days of *highly paid manual labour* we have to look very closely at the *cost* of an operation of this kind, and *feel sure* it is *worth it* before we employ it on an extended scale.

"The Black Currant is so easily grown from CLEAN *cuttings* in the course of three or four years to good-sized bushes, and bearing freely, that the cleaning of old bushes at a considerable cost is not, I think, judicious. Much better to clear off the bushes root and branch, and burn every morsel of them on the spot. Grow other crops on the land till all *Black Currant Mites* are starved out, and the *remedy is complete.*

"(5.) *Mixed cropping, or alternate rows of Black Currants and Gooseberries.*—An excellent method of growing Black Currants, whether the intermediate crop is Gooseberries, Strawberries, or vegetables, because it allows more freedom in dealing with each row of Black Currants, and if they should become infested with Mites, there would be more room to reach them than when crowded into rows four to six feet apart, in the usual way, where men can hardly push their way through between them.

"I have reason to believe that the usual method of *close rows,* in *large breaks* or quarters of Black Currants, has a good deal to do with the bad attack of Mites so often seen on massed bushes; while single rows, with free space of some feet or yards between them are less infested in the same district. The close rows naturally afford better *shelter* and more *breeding ground* than detached rows, and hence the partial immunity of the latter.

"Still, after all, if Mites are present in a garden, you are never safe to allow them to remain, and think they will *not* spread! Let a favourable season for the Mite come round, and their advance will astonish you! It is then too late to apply a remedy that will be worth the cost. The *proper time* is the *first sign* observed of the presence of the Mite. *Attack it then,* and it may *quickly be exterminated.* Let it run its course for a season or two, and attempts to clear it off (short of burning every infested bush) are more likely to end in failure than success.

"There is little doubt the workers rubbing on the infested bushes with their clothes, when the Mites are *lively,* carry them to clean

bushes and spread the infestation. *Birds, wind,* and *infested prunings* do the same thing! No wonder then that the pest spreads rapidly when once it gets a foothold in a break of Black Currants.

"The best protectives are *clean ground; clean* and *vigorous* young bushes, *wide apart; high cultivation;* and a *watchful eye* on the *first sign* of a *Mite,* and its IMMEDIATE DESTRUCTION!"

From comparison of the various observations of careful work under the superintendence of well-known managers or owners of large breadths of Black Currant ground, it seems clearly shown that at present none of the preventive measures tried can be trusted to as permanently serviceable (and even the removal of the galled buds which must necessarily destroy a part of the infestation) by no means acts satisfactorily.

But there is one point in method of growing which is alluded to above in the replies to my enquiries with which I was favoured by Mr. Malcolm Dunn, and which I believe would be of great practical importance both in lessening spread of infestation, and in laying open what *is* present, much more to observation, and consequent remedial measures (to be applied *at once* on observation) than is at present the case.

This is, the growing of Currants in lines, or long plots, with other crops between, instead of, as is often the case at present, growing the bushes together year after year on the same ground, and even up to areas of several acres. In this present way, besides the spread of Mites from bush to bush in their migrations, which it is impossible to guard against, there is in all probability a great spread of Mites by carriage on the clothes of "pickers," or other workers who have to move amongst the bushes (and in the first case at least) cannot avoid their hands and sleeves coming much in contact with the stems during the removal of the fruit. As we all know there are some practical difficulties in the way of intermediate lines of crop by reason of the long distance to which the roots of the Black Currants spread from the bushes; still in the very great difficulties in which we stand at present, I believe that the intermediate cropping is well worth consideration, and that until the elaborate and careful experiments mentioned below, which are being instituted at the Experimental Fruit Farm at Woburn, afford us better preventive guidance than we have at present, that it is to separation of the great masses of infested bushes that we must look, to give us opportunity of in some degree preventing the spread of the infestation.*

* The following note with which I was favoured on January 20th by Mr. Lewis Castle, Manager of the Woburn Experimental Fruit Farm, from Ridgmont, Aspley Guise, Bedfordshire, gives some very serviceable observation on the above point:—

"Upon reflection, I think your suggestion with regard to planting Black

By kind permission of Mr. Spencer Pickering, F.R.S., Director of the Woburn Experimental Fruit Farm, I am permitted to insert the following account of the experiments now in progress, and also the proposed course of treatment arranged after much consideration of the requirements of the case.

The following note, with which I was favoured by Mr. Pickering on January 29th of the present year, gives a short general preliminary statement of work in progress or under contemplation :—

"The scheme of investigation which I have adopted with the Black Currants is as follows :—

"Two separate plantations are each apportioned to experiments with paraffin, calcium sulphide, antinonnin, and carbolic acid. In each case there are plots in which the insecticide is used in four or five different strengths. The dressings will be applied once a month. After the buds begin to expand, the plots will be subdivided, and in one section of them the dressing used previously will be continued, and in the others weaker dressings of various strengths will be applied. There are also various other experiments.

"I propose at intervals of time to have the buds examined to see whether the Mite is still vigorous. This need be done, in the first instance, only with those where the strongest doses have been used." —(S. P.)

The following notes forwarded to me on January 14th of the present year give particulars of what has already been done at Woburn in regard to the Currant Mite ; and also give information as to the varieties of Black Currant under observation, time of planting, date of appearance of infestation, and treatment of various kinds :—

Woburn Experimental Fruit Farm.

Black Currant Bud Mite.

"Varieties Grown.—Baldwin's Black, Black Naples, Lee's Prolific, Carter's Champion, Agden's Black, Old Black.

"Time of Planting.—The majority were planted in trenched ground in the autumn of 1895 and the spring of 1896, but a few were planted in the autumn of 1894.

Currants in lines between other crops is important, and likely to prove beneficial where the plantation was gradually formed, and the bushes may be obtained from various sources. The fact that ours are all planted in such lines may have been partially the means of preventing the more general extension of the 'Mite,' which is at present mainly confined to the one plot of Baldwins, though instances are observable in other plots, but scattered. Certainly it should be practised wherever it can be done conveniently, as bushes and trees of all kinds in single lines alternating with others ripen both wood and fruit better than when crowded into dense plantations."—(L. C.)

"Appearance of Infested Buds.—1895: A few buds were observed, but no general attack, and these were at once removed and burnt.

"1896: This year the buds were much more numerous, particularly on Baldwins; but they were again carefully removed and burnt.

"1897: Baldwins were found to be seriously affected before the fruit was all gathered in July and August. The removal of the buds would have been a tedious and expensive process, and seemed to be ineffectual; the following methods were therefore adopted with the Baldwins.

"*While the foliage was on the bushes.* — The whole of the bushes were watered or syringed with diluted calcium sulphide of different strengths. No effect was observed.

"*After the foliage had fallen.* — 1st. Plants cut down close to the soil. The stumps to be dressed with an insecticide, and the roots to be heavily manured. Every piece of growth bearing buds was removed. Subsequently some of the stumps were cut down to the roots.

"2nd. Plants dug up, and the whole of the stems dipped twice in the following solutions before replanting:—

A = carbolic acid, 1 pint to 16 gallons water (proportion 1 : 128).

B = carbolic acid, 2 pints to 16 gallons water (proportion 1 : 64).

C = carbolic acid, 3 pints to 16 gallons water (proportion 1 : 43).

D = calcium sulphide solution, 1 quart to 16 gallons water (proportion 1 : 64).

E = calcium sulphide solution, 2 quarts to 16 gallons water (proportion 1 : 32).

F = calcium sulphide solution, 3 quarts to 16 gallons water (proportion 1 : 21).

"3rd. Plants not lifted or cut. Watered three times with the following from a rose-can:—

A = carbolic acid, 3 pints to 9 gallons water (proportion 1 : 24)

B = calcium sulphide, 3 quarts to 9 gallons water (proportion 1 : 12).

C = petroleum 2 quarts, soft-soap 1 lb. to 18 gallons water (proportion 1 : 36).

D = petroleum 3 quarts, soft-soap 2 lb. to 18 gallons water (proportion 1 : 24).

E = petroleum 2 quarts, soft-soap 2 lb. to 9 gallons water (proportion 1 : 18).

"4th. Plants not lifted, watered, or cut. The whole of the stems and buds were painted with the following mixture:—

A = calcium sulphide 3 quarts, clay 10 lb., water 2 gallons (proportion 1 : 2·7)."

The following notes give, firstly a general sketch of the course of

treatment and experiments proposed on January 13th, to which is appended a rather fuller scheme of the experiments to be carried out so far as is possible on the bushes mentioned in the preceding list, and also on a fresh lot of bushes which have not as yet been treated :—

"Course of treatment and experiments, 1898. Discussed and proposed January 13th, 1898 :—

"1st. To continue applications of the various insecticides (especially petroleum and soft-soap mixtures) throughout the season at frequent intervals; increasing the frequency of application when the buds are opening.

"2nd. To give heavy dressings of kainite, sodium nitrate, or other fertilizers.

"3rd. To cut down stems below the soil level, and cover with lime or kainite.

"4th. To raise seedlings from the least affected varieties.

"5th. To graft upon *Ribes aureum* or other species of *Ribes* which have hitherto proved free from attack.

"Experiments with *petroleum*.—Soft-soap added in the proportion of 1 lb. to each quart of petroleum. The various strengths used are as follows:—A = 1 : 10 (of water), B = 1 : 20, C = 1 : 30, D = 1 : 40, E = 1 : 80. Two sets of similar experiments to be made with Baldwin and Black Naples respectively. In each individual experiment (No. 1, 2, &c.) the bushes are dressed once a month while the buds are dormant with one of the above solutions, and after the buds start the plots are subdivided, and parts of them dressed once a month with different strengths :—

Experiments :	1	2	3	4	5	6
Before growth, dressed with	Sol. A	B	C	D	none	none
After growth, dressed with	a soln. A b ,, B c ,, C d ,, D e ,, E f ,, none	a soln. B b ,, C c ,, D d ,, E e ,, none	a soln. C b ,, D c ,, E d ,, none	a soln. D b ,, E c ,, none	a soln. E b ,, none	none

"There will be about six plants in each of the final subdivisions.

"Experiments with *calcium sulphide* solution.—Repeated on two lots of Baldwins. Similar to the petroleum experiments, except that four different strengths only are used. Strengths used:—1 : 20, 1 : 30, 1 : 50, and 1 : 100.

"Experiments with *carbolic acid* on two lots of Baldwins, similar to those with calcium sulphide. Strengths used :—1 : 30, 1 : 50, 1 : 100, and 1 : 200.

"Experiments with *antinonnin* on Black Naples; one series only,

similar to those with petroleum. Strengths used:—1 per cent., 0·5 per cent., 0·25 per cent., 0·1 per cent., and 0·05 per cent."

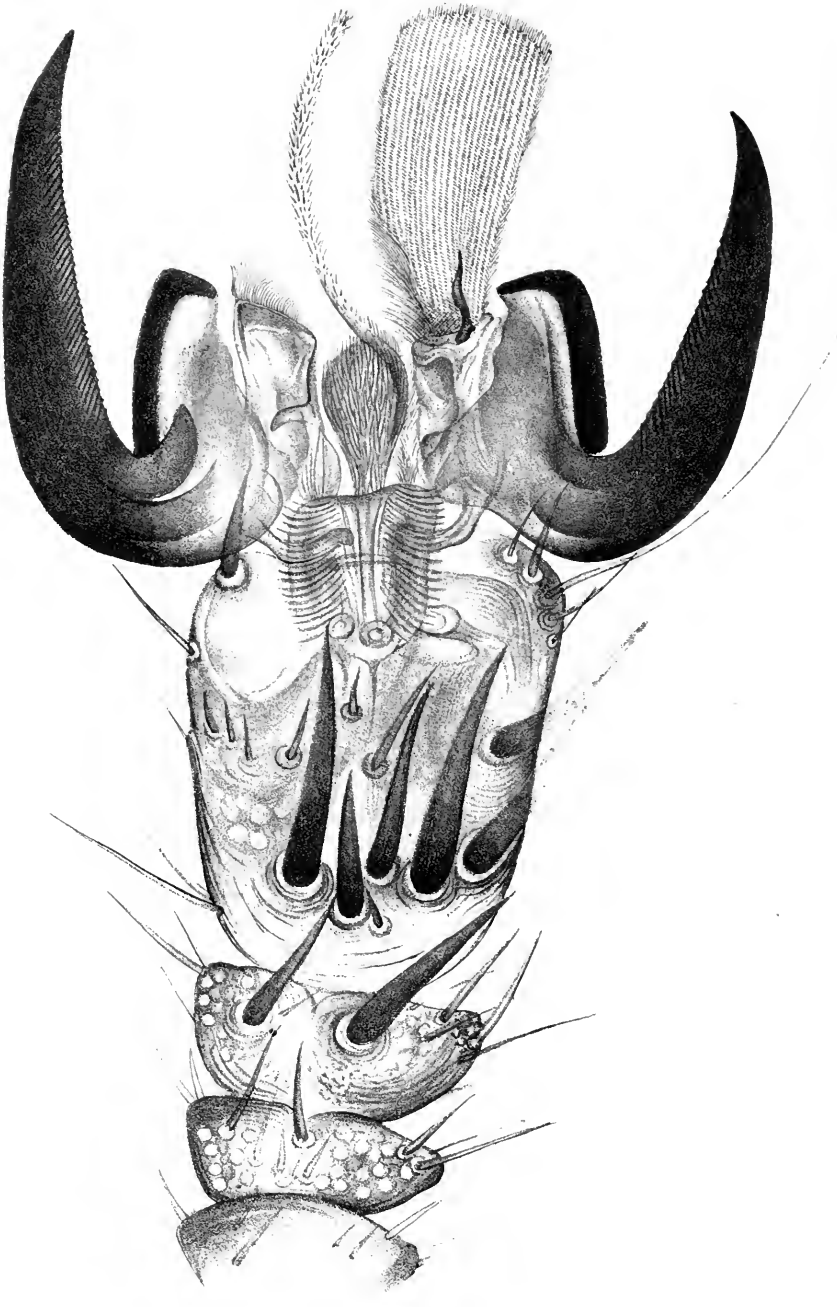
The above plan of treatment, it will be observed, includes,—specification of the nature of the different chemical applications with which it is purposed to experiment; the various strengths at which they are to be used; also how often they are to be used; and under what conditions of the plants. It is also purposed, by microscopic examination of contents of the galled buds which have been subjected to treatment, to ascertain precisely what the effect of the various applications has been in preventing infestation, or destruction of Acarine contents where growth has started.

From these experiments, as well as from such as turn on various methods of horticultural treatment of the bushes, it is greatly to be hoped that serviceable practical information will be gained, of which at present all Black Currant growers stand in great need.

INDEX.

APPENDIX.

WEST, NEWMAN AND CO., PRINTERS, HATTON GARDEN, LONDON, E.C.



Horace Knight ad nat. del.

West Newm[illegible]

Foot of Forest Fly (Hippobosca equina *Linn.*)
Seen from above greatly magnified.

REPORT OF OBSERVATIONS

OF

INJURIOUS INSECTS

AND

COMMON FARM PESTS,

DURING THE YEAR 1898,

WITH METHODS OF

PREVENTION AND REMEDY.

TWENTY-SECOND REPORT.

BY

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NATURALISTS' SOC., CAPE COLONY.

LONDON:
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1899.

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PREFACE.

During the past season there has been more than usual variety in the amount and also in the kinds of insect infestations. In a few instances these have been *more* than usually numerous, in some *less* observed than is ordinarily the case; a few species that are very rarely noticed were reported, and also one or two observations of extension of locality of somewhat serious infestations have been given.

Amongst attacks that were unusually present, *Aphides*, or "Blight," were especially named; and later in the year widespread loss was caused in many places to Cabbage growers, and also in private gardens, by the visitation of caterpillars of different species of Cabbage butterflies (*Pieris*), which appeared almost in flocks, and set on foot little short of complete devastation. Amongst fruit attacks, that of the Pear Gnat Midge (*Diplosis pyrivora*), causing destruction of the young forming Pears, was much more prevalent than in any year since 1883, when its presence was first recorded in this country.

Amongst infestations which have been very little noticed previously is that of the Pith Moth (*Laverna atra*), of which the maggot destroys entire bunches of Apple blossom-buds by tunnelling up the shoot immediately beneath the cluster. This attack has probably long been present, but not distinguished from another very similar in its effects, and it being brought forward may be certainly expected to enable orchard growers to get rid of it to a great extent. The "Ground Beetles" (*Pterostichus* and other allied kinds, which have been so injurious for the last few years to Strawberry fruit, and for the ravages of which simple remedial measures have now been reported, see pp. 124–126) again appeared as a field crop pest to Mangold roots; also the "Pigmy Mangold Beetle" (*Atomaria linearis*), an insect almost too small to be noticed excepting in the collections of hundreds or thousands in which it attacks the germinating or young Mangolds, again showed itself. Potato haulm has for some years been occasionally reported from various localities as being seriously injured by the tunnelling of a moth caterpillar for many inches up the stem, and from last season's observations this appears to be the work of *Hydrœcia micacea;* but two species may be present, and as one of these would be very easily kept in check, but not the other, more information is needed. Hops in a few places were much injured by the Clay-coloured Weevil

(*Otiorhynchus picipes*), not previously reported as injurious to this crop, although causing severe loss in fruit grounds.

Amongst timber infestations, notes were sent for the first time, of damage caused by two species of a small timber-boring beetle (*Trypodendron*) by tunnelling into the outside wood of, respectively, felled Pine and of deciduous trees, and more information regarding the attack would be very desirable.

The observation of presence of Horse Forest Fly, *Hippobosca equina* (which was formerly supposed to be almost entirely confined to the neighbourhood of the New Forest), as occurring to an extent to cause serious inconvenience in a district of Glamorganshire, and the adjacent part of Brecknockshire, is of considerable practical interest. I have also amongst the reports mentioned damage to cattle *popularly* attributed in some districts in Ireland to what is called the "Murrain Worm" (see p. 72), as, though the caterpillar is perfectly harmless, the illness appears to be very real, and it may arise from eating poisonous water-plants, growing in the same localities as those on which this Sphinx moth caterpillar feeds.

Few inquiries have been sent as to damage to corn crops caused by the ordinary stem or grain insects, although the general root pests of Wireworm, and Daddy Longlegs grubs, were notably present; and Stem Eelworm, causing Tulip-root in Oats, was present, and also did widespread and serious mischief in late winter and early spring by causing Stem-sickness in Clover.

"Surface caterpillars," which are usually very troublesome at root crops, and leafage caterpillars, which in a hot dry May are sometimes a complete devastation to orchard leafage, were little inquired about.

The following list gives the names of most of the attacks regarding which I received applications, classed for convenience of reference under headings of the names of the Orders to which they belong:—

Beetles (*Coleoptera*).

Asparagus Beetle, *Crioceris asparagi*	Asparagus shoots.
Bacon or Larder Beetle, *Dermestes lardarius*	Bacon, &c.
Bone and Leather Beetle, *Dermestes vulpinus*	Bones, wood, &c.
Chafer, Cockchafer, *Melolontha vulgaris*	Leafage and roots.
,, Rose, *Phyllopertha horticola*	Flowers, leafage, and roots.
Death-watch Beetles, Paste, *Anobium paniceum*	Stores, seeds, &c.
,, ,, Wood (striped), *Anobium striatum*	Woodwork and furniture.
,, ,, ,, (tessellated) ,, *tessellatum*	,, ,, ,,
Grain Beetle (Saw-toothed), *Silvanus surinamensis*	Corn and stores.
Ground Beetles, *Calathus cisteloides*	Strawberry fruit.
,, ,, *Harpalus ruficornis*	Strawberry fruit & Mangold roots.
,, ,, *Pterostichus madidus*	,, ,, ,,
,, ,, ,, *vulgaris*	,, ,, ,,
Lady-bird Beetle, *Coccinella septempunctata* (beneficial).	Aphides.
Mangold Beetle (Pigmy), *Atomaria linearis*	Young Mangolds.
Mustard Beetle, *Phædon betulæ*	Mustard.
Oak-borer, *Trypodendron domesticum*	Wood of deciduous trees.
Pine-borer (Striped), *Trypodendron lineatum*	Wood of conifers.
Pine Timberman, *Astynomus ædilis*	Pine logs.
Weevils, Apple, Oblong-leaf, *Phyllobius oblongus*	Orchard leafage.

Weevils, Apple-blossom, *Anthonomus pomorum*	Apple flower-buds.
,, Granary, *Calandra (Sitophilus) granaria*	Stored grain.
,, Pea and Clover, *Sitones* (of various species)	Leafage.
,, Raspberry, Clay-coloured, *Otiorhynchus picipes*	Orchard, Hops, &c.
,, Red-legged, *Otiorhynchus tenebricosus*	Pear, &c.
,, Vine, *Otiorhynchus sulcatus*	Vine, &c.
,, Turnip-seed, *Ceutorhynchus assimilis*	Turnip seed-pods.
Wireworms (larvæ of different species of Elaters)	Roots of Grass and crops.

Butterflies and Moths (*Lepidoptera*).

Antler Moth, *Charæas graminis*	Grass roots.
Buff-tip Moth, *Pygæra bucephala*	Apple leaves.
Cabbage Butterflies (*Pieris* of various species)	Cabbage.
Codlin Moth, *Carpocapsa pomonella*	Young Apples.
Diamond-back Moth, *Plutella cruciferarum*	Turnip leaves.
Eyed Hawk Moth, *Smerinthus ocellatus*	Apple leaves.
Goat Moth, *Cossus ligniperda*	Live wood.
Lappet Moth, *Gastopacha quercifolia*	Apple leaves.
Magpie Moth, *Abraxas grossulariata*	Gooseberry & Currant leaves.
"Murrain Worm," Elephant Hawk Moth, *Chærocampa elpenor* *	Plants near water.
Pith Moth, *Laverna atra*	Apple shoots.
Pale Tussock Moth, *Dasychira pudibunda*	Hop (also Apple) leaves.
Potato-stem Borer, *Hydræcia micacea*	Potato stems.
Privet Hawk Moth, *Sphinx ligustri*	Privet leaves.
Surface Caterpillars (*Agrotis* of various species)	Turnips, &c.
Winter Moth, *Cheimatobia brumata*	Orchard leafage.
Wood Leopard Moth, *Zeuzera æsculi*	Wood of branches, Pear, &c.

Two-winged Flies (*Diptera*).

Cabbage & Turnip-seed Gnat Midge, *Ceutorhynchus assimilis*	Turnip seed.
Daddy Longlegs, *Tipula (oleracea,* &c.)	Roots of Grass.
Great Ox Gad Fly, *Tabanus bovinus*	Cattle.
Grouse Fly, *Ornithomyia avicularia*	Grouse.
Hawthorn Gnat Midge, *Cecidomyia cratægi*	Ends of Hawthorn shoots.
Horse Bot Fly, *Gastrophilus equi*	Horses, internally.
Horse Forest Fly, *Hippobosca equina*	Cattle and Horses.
Ox Warble Fly, *Hypoderma bovis*	Hides of Cattle.
Pear Gnat Midge, *Diplosis pyrivora*	Pear blossom-buds.
Sheep's Nostril Fly, *Œstrus ovis*	Nostrils of sheep.

Fleas (*Aphaniptera* = *Siphonaptera*).

House Flea, *Pulex irritans*	Man.

Sawflies, Bees, &c. (*Hymenoptera*).

Hornet, *Vespa crabra*	Fruit, &c.
Leaf-cutter Bee (larvæ), *Megachile (? centuncularis)*	Leaves.
Sirex (Giant), *Sirex gigas*	Pine timber.
"Slugworms," larvæ of Pear Sawfly, *Eriocampa limacina*	Pear and Cherry leaves.
Wasp, *Vespa germanica*	Fruit, meat, &c.

Aphides, Scale Insects, &c. (*Homoptera*).

Aphis, Apple, *Aphis mali*	Leaves.
,, Larch, *Chermes laricis*	Young shoots and leaves.
,, Turnip,	Turnip leaves.
,, Woolly Apple, American Blight, *Schizoneura lanigera*	Apple bark.
,, ,, Pine, *Schizoneura fuliginosa*	Pine leaves.
Apple Scale, *Mytilaspis pomorum*	Bark.
Currant and Gooseberry Scale, *Leucanium ribis*	Bark.
Suckers, Apple, *Psylla mali*	Stems of flower buds.

* This entry is inserted relatively to a popular belief in Ireland that the larva causes "murrain" to cattle! See pp. 72–75.

Besides the above insect pests, other allied kinds were present as usual; notably the Black Currant Gall Mite (*Phytoptus ribis*), which, from the careful attention which is being devoted to the subject, we hope may presently be brought more under control; the Filbert Gall Mite (*P. avellanæ*) was more than usually present. Eelworm attacks have been alluded to above, and Millepedes, as matter of course, were reported as troublesome, besides other incidental infestations forwarded for identification and information as to remedial measures, but without notes of habits, &c., which are always much to be desired for increase of our knowledge.

The amount of application both regarding insect attacks *at once* requiring attention, and also inquiry correspondence connected with the subject, has so much increased that I have difficulty at times in attending with the promptness which I always wish to do to applicants, and also in carrying on research, both personal and by correspondence with observers of little-known attacks, which is needed to learn their life-histories as occurring in this country. Also much time is taken by attention to inquiries regarding *ordinary* attacks which have been frequently entered on in my foregoing Annual Reports, and I believe are now so generally known both to agriculturists and orchard-growers that reference to them would not convey any new information to my readers.

Therefore, by advice of friends, I this year publish, in addition to my Annual Report, a "General Index" of the whole series, as an assistance in reference to those possessing the set, with a short digest preceding of the main points regarding special observations of our more important insect attacks which have been contributed in the past twenty-two years.

So long as health sufficient for the work is granted me, and I am honoured by being asked to assist, it is only a pleasure to me to endeavour to do my very best, and I hope to continue to publish yearly results, but with a little difference in the plan, so that I may utilize *short notes* of useful means of prevention and remedy sent me, *in a separate section* following the body of the Report, and under a distinctive heading. Thus I hope that we may gather up *all* information sent, but without encumbering the Reports with *repetition of figure and description*, save where necessary. With these slight differences (and all being well) I propose to commence a new issue as a "Second Series."

With regard to assistance in the work, which is increasingly becoming more than can be dealt with by one person, I have much help in secretarial matters from my resident lady secretary, Miss Hartwell; but in much press of application and occasional illness in the past year, I have found great need of a scientific entomological colleague to whom, in order to save delay, I might apply as occasion required to give desired information to applicants, and also who would oblige me by co-operation in extreme cases of minute microscopic investigation.

I have therefore, through the kind courtesy of Mr. Robert Newstead, Fellow of the Entomological Society, Curator of the Grosvenor Museum, Chester, made arrangements with him which, by permitting me to communicate with him if occasion arises, remove my fear of difficulties occurring on the above heads, and give me great satisfaction, as I have long been acquainted with his careful insect investigations, and his great powers of microscopic observation and delineation, for examples of which I may refer to the forthcoming volume on *Coccidæ*, prepared by him for publication in the Ray Society. To the above I may add that any contribution with which I may be favoured by Mr. Newstead will be most fully acknowledged to him in my pages.

Of the figures in the present Report, I beg to acknowledge with thanks those at pp. 127 and 130 as being by permission of Messrs. Blackie & Son, of Glasgow; those at p. 12 and heading of p. 78 I have been permitted the use of from the 'Gardeners' Chronicle' set; the figures of moths at pp. 1 and 72 are from Newman's 'British Moths'; the figure at p. 5 from 'Insects Injurious to Fruit (in Canada),' by Dr. W. Saunders. The other figures, excepting where acknowledgement is given accompanying or in the letterpress, have mostly been drawn expressly for my own publications.

Once again (as in what are now *many* former years) I desire to express my cordial thanks for the encouragement and assistance in my work given me from too many kind helpers and friends for me to express my thanks adequately. But I would wish especially to acknowledge much encouragement from our British agricultural and frequently from the general Press; also the liberal donations of serials bearing on prevention of insect ravage which I am constantly in receipt of from our Colonial Departments, from the Continent, and from the Agricultural Department, Washington, U.S.A., and its many co-operating stations, for all which, and much other kindly assistance, I most heartily thank my kind and helpful friends.

ELEANOR A. ORMEROD, F.E.S.

Torrington House, St. Albans:
March, 1899.

Note.—The General Index is now almost completed, and will be forwarded on publication to colleagues who are customarily recipients of the Annual Reports. It will also be purchasable if desired; see advertisement inside first page of wrapper for particulars.—E. A. O.

List of Injurious Insects, &c., noticed in this Report.

* The two species of *Trypodendron* are placed in sequence for convenience of reference.

NOTES OF OBSERVATIONS

OF

INJURIOUS INSECTS

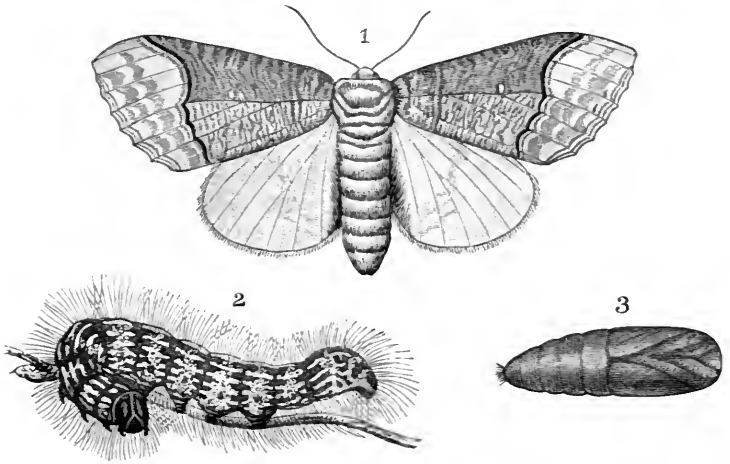
AND

COMMON CROP PESTS

During 1898.

APPLE.

Buff-tip Moth. *Pygæra bucephala*, L.



Pygæra bucephala.—1, moth; 2, caterpillar; 3, chrysalis.

The caterpillars of this fine moth, figured above, are very general feeders, and are recorded as infesting the leafage of the Alder, Birch, Beech, Elm, Hazel, Lime, Oak, Poplar, Willow, &c.; and in October (1887) I had fine specimens sent me which had been taken at Rathdrum, Ireland, on "Evergreen Oak" (*Quercus Ilex*), and which were feeding voraciously on the pieces of Evergreen Oak sent with them. But I am not aware of the infestation having been recorded as often

injurious to leafage of orchard trees, and it was not until the past season (1898) that I received inquiries as to the caterpillars doing a good deal of harm, at the localities noted below, to Apple leafage.

On May 10th Prof. F. O. Solomon wrote to me from the Durham College of Science, Newcastle-on-Tyne, as follows:—

"Is the 'Buff-tip' Moth (*Pygæra bucephala*) in the habit of doing much injury to Apple trees? Last summer I found a young Apple tree (just commencing to bear) *entirely cleared of its leaves* by the caterpillars. I collected several of the grubs, and the moths emerged from the chrysalis last, and this, week, so that there is no doubt of the insect. Of course I know the caterpillars devastate Lime and some other trees, but did not know they damaged Apple trees. . . . I got my caterpillars from a young orchard near Dartford, in Kent."—(F. O. S.)

On August 31st I received caterpillars of the same species, *Pygæra bucephala*, from Mr. D. Beckwith, Easingwold, Yorkshire, with a request for information as to their name, and how best to prevent the spread of the infestation.

Mr. Beckwith mentioned that he had found some specimens that day "on an Apple tree of 'Duchess of Oldenburg' variety." They had devoured every leaf on one side of the tree. "I also observed that a small Apple tree—a maiden—planted last year, and consisting of just one straight stem, about twenty-seven inches high, had been entirely stripped of its leaves in like manner, but I could not find any caterpillar about it, and no other trees, as far as I have discovered (although there are over a thousand in the orchard), are affected. . . . It would be a very serious matter for me if they were to spread."—(D. B.)

The complete clearance of the leafage from the trees, or parts of trees, attacked by the hordes of these caterpillars is one of the characteristics of the infestation. On August 19th, 1884, specimens were forwarded me from Llanerch, Llanelly, South Wales, which had been found attacking young Oaks in the nursery, with the remark that they had, when noticed, "entirely stripped two or three young trees of their leaves, and then were clustered together on the twigs in much the same way as the Pine Sawfly caterpillars on Scotch Fir, and were doing their work quite as thoroughly."

On August 27th, 1887, caterpillars were sent me from Ockbrook, Derby, which had been taken from a Broad-leaved Elm, with the observation from the sender that when he saw them first, about twelve o'clock that morning, they were in hundreds on one large branch, and had entirely stripped that one branch of its leaves. On going again in the evening, about six o'clock, only a comparatively small number were observable. (Presumably the caterpillars were leaving the tree to turn to the chrysalis state.—E. A. O.)

The moth is usually from two and a quarter to two and a half inches in expanse of the fore wings, which are of a pearly grey ground colour, inclining to a more purple tint towards the fore edge, and a silvery grey at the base, very near which is a transverse brown line, and a little beyond this is a transverse bar formed of three brown lines. Another brown bar starts near the tip of the wing, and after making a semicircular curve (see figure, p. 1), crosses the wing transversely with a zig-zag line. Between this and the brown bar the wing is marked with many fine-waved transverse lines, and outside the semicircular curve the tip of the wing is occupied by a large ochreous or buff-coloured blotch, whence the moth takes its name of "Buff-tip." The hind wings are yellowish white, somewhat clouded towards the middle. The head is ochreous; the body between the wings with a double brown line on each side and behind, and the abdomen dingy ochreous.

The moths are to be found pairing about the beginning of June. Directly afterwards, the eggs are stated * to be laid, up to as many as thirty to sixty in a patch, mostly on the upper side of a leaf. These are convex and white or greenish above, with a black dot in the middle of the convex portion; beneath they are flat and of a smoky colour.

The caterpillars hatch in about a fortnight, and at first feed together on the upper skin and tissue of the leaf, leaving the veins uninjured. After eight days they moult, and then separate into little companies of six to ten, each party betaking itself to the tip of a leaf, and feeding at the edge in the common caterpillar manner; towards the end of July they are full-fed, and their presence may be known by the mischief they have caused, the various broods having stripped the leafage from the boughs where they have established themselves "as bare as if in the depth of winter."

When hatched, the caterpillars have large shining black heads and narrower yellow bodies, with soft hairs, and a series of black spots, which are most noticeable along the middle of the back. When full-grown, the colour is more varied. The head is still black, but it is covered with minute punctures, and has a yellow mark, like a V reversed on the face; it is covered with fine silky hairs, as is also the body, which is now of a yellow ground colour, marked along the sides with an orange transverse streak about the middle of each segment, and, alternately with these, with an ill-defined and sometimes scarcely observable whitish mark on the segmental division. Nine longitudinal stripes of more or less elongate black blotches run along the back and

* I have not myself had the opportunity of observing the whole life-history, and therefore give (with due acknowledgment) some of the main points recorded by Newman in his detailed account of this species, given in 'British Moths,' pp. 219, 220.

sides, from the third to the twelfth segment inclusive, of which the row down the middle of the back is the broadest and the most observable. The spiracles are black, so also are the claw- and sucker-feet for the most part (unless yellow within). The caterpillar is full-grown in September, when it changes to the pupal state, which is dark brown, punctate, and shining, terminating in two forked processes (see figure, p. 1).

When the time for their change has come, the caterpillars descend the stems of the trees, on the leaves of which they have fed, and crawl actively in any direction that may suit their views, whether over dusty roads, flagged pathways, or anywhere else, till they find a suitable locality for turning to the chrysalis state, under fallen leafage, or in other shelter, or at the surface of the ground, without the protection of any web or cocoon.

I had the opportunity of watching the damage caused by these caterpillars on roadside trees whilst for some years I was resident at Spring Grove, near Isleworth ; but, not being able to give their habits in full detail, much of the above is abridged from Newman's 'British Moths,' p. 3, as stated in the foot-note.

Prevention and Remedies.—The best methods are shaking the caterpillars down and destroying them, catching and killing the moths when they are found coupled on the trunks of the trees which they frequent, or collecting the caterpillars or turning on poultry to clear them away from beneath the trees of which they have been observed on the leafage.

To collect the caterpillars.—Jarring or shaking the branches causes them to fall in great numbers. Any method which gives a good hard shake will answer the purpose, such as use of a pole, or throwing sticks or handfuls of gravel at colonies that may be out of reach. If they are high up on a tree, up which a man can safely climb to within reach of them, an old worn-down birch broom fastened at the end of a long pole is a very good implement. Beginning at the highest of the infested branches and working downwards, the caterpillars which may have caught on the lower boughs can thus be dislodged, and the worn-down stump of the broom makes a good instrument for raising the smaller boughs sharply, so that they come down again with a jerk, and also it will beat the boughs without there being danger (as in the use of a hard and heavy pole) of injuring soft bark.

Directly the caterpillars reach the ground, it is likely that they will turn their heads to the tree from which they have been shaken, and re-ascend the stem and re-establish themselves. Therefore it is desirable, before beginning operations, to put a band of hay or straw, well tarred, on the ground round (but clear of) the foot of the tree

to keep them from going up again, and to capture and kill the grubs as soon as possible in any way which may be convenient. Simply trampling on them will kill many, or, as the great size and bright colouring of the caterpillars make them very conspicuous, children would soon collect large numbers for a small payment. Where the infestation has been bad enough to make it worth while to spread sheets or cloths beneath the tree before jarring, this would save a deal of trouble in collecting, for the caterpillars might be shaken together and thrown (before they had time to escape) into pails of any mixture which would kill them.

The large size of the insect, and its habits in all its stages, throw it open to easy methods of prevention. "At the beginning of June these singular moths may be frequently found coupled in pairs on the trunks of Lime, Elm, and other trees, or on the herbage below them; the truncate heads and closely convolute wings giving each pair the appearance of a single piece of dead and dried stick." * By destroying these moths much egg-laying will be prevented.

As the chrysalids are not protected by any web or cocoon, they are very noticeable, or may easily be found by a little search on the surface of the ground or at the roots of herbage or under slight shelters beneath attacked trees, and for a small sum children might collect great numbers under trees that have been much infested. Poultry also are fond of them, and are stated to search for them with great eagerness.

Eye-spotted Bud Moth; Red Bud Caterpillar.

Tmetocera ocellana, Schiff.; *Hedya ocellana*, Fab.

TMETOCERA OCELLANA.—Eye-spotted Bud Moth and caterpillar.

The "Red Bud Caterpillars" of *Tmetocera ocellana* cause much injury both in Europe and America to Apple, and also to various other kinds of orchard fruit trees, but I have only once had definite observations of their mischievous presence in this country. Probably if the signs of the attack were generally known they would be found to be much more present than is supposed, as well as those of the "Pith Moth," *Laverna atra*, mentioned in the following paper, which they

* 'British Moths,' p. 219.

much resemble in size and general appearance, as well as date of appearance in the spring, and likewise by the presence of the attack in the spring being noticeable by the fading state of the blossoms and buds and the withering of the leaves.

But though, like the Pith Moth caterpillar, that of the Eye-spotted Bud Moth sometimes burrows a little way within a shoot, its attack is altogether of a much more external kind,—that is, as a definite injury to buds, also to blossoms and the accompanying leaves, and spinning them together; and further on in the season, by attack to leafage, of which they feed on the tissues and skin of (usually) the lowest side.

The only account which I have received of injury from this *Tmetocera ocellana* in this country was given me in 1889 * by Mr. Oliver E. Janson, when, early in May, he noticed the unhealthy appearance of many Apple trees in orchards and gardens in the neighbourhood of Hornsey (near London), and as he afterwards found some dwarf Apple trees in a garden conveniently situated for observation similarly affected, he "examined these more closely, and found the young leaves remaining stunted and shrivelled, instead of fully expanding; and towards the middle of the month all of the young shoots, many of them just showing blossom, began to droop and wither, and by the end of the month every young shoot had withered."

Various points of the observations agreed equally with descriptions of method and signs of infestation of both the Pith Moth and the Eye-spotted Bud Moth, and such turned out to be the case.

On June 8th the first moth appeared from a quantity of infested shoots which Mr. Janson had cut off and secured in glass jars under fine gauze coverings, and proved to be *Tmetocera* (=*Hedya*) *ocellana*, the Eye-spotted Bud Moth, and of this the moths continued to emerge in great numbers up to the 20th of the month.

"A few days later, and on till the middle of July, a considerable number of specimens of another moth, the *Laverna atra* (one of the Tineina), also emerged from the same shoots."

Of this infestation I have given an account in the following paper. It appears to have been very little written upon; but the *Tmetocera* has been the subject of much observation. So long ago as 1837 an account of its habits as a European fruit pest were given by Schmidberger in Kollar's 'Insects'; a short paper was given on it by Prof. W. Saunders, Director of the Experimental Farms of Canada, in his very useful volume entitled 'Insects Injurious to Fruits'; but it was not until more recently that the infestation was very fully entered on from his personal observations by Dr. J. Fletcher, Entomologist of the Dominion of Canada; and more recently still, with great minute-

* See my Thirteenth Annual 'Report of Injurious Insects' for 1889, pp. 81–84.

ness and excellent illustrative figure, by Prof. M. V. Slingerland, of Cornell University, N.Y., U.S.A.*

The life-history, taken in its main points from these two observers, is that the half-grown caterpillar, which may be about the sixth of an inch in length, passes the winter enclosed in silken web cells on the bark of twigs of Apple or other fruit trees. In spring it comes out of its case as a little brown larva, with a black head and black plate on the following segment, and gradually grows until in June it is about half an inch long, slightly hairy, of the above-mentioned colours, and with the legs also black.

The destructive work is begun by the caterpillars leaving their cells and creeping to the nearest swelling and opening fruit and leaf-buds, which they eat into; but it is noted by Prof. Slingerland:—"More often the caterpillar does not begin its work until the buds are nearly half-opened. It then feeds upon the central expanding leaves or flowers, tying them together with silken threads. Some of the partly-eaten leaves soon turn brown, and thus render the work of the insect quite conspicuous; one correspondent wrote that his trees looked as though a fire had swept quickly through them, as so many leaves had turned brown. This tying together of the opening leaves and flowers, and the brown appearance of many of them, are the most characteristic indications of the presence of the insect."

The caterpillars are stated to go on feeding in the spring for about six or seven weeks, mostly at night, and to turn to the chrysalis state "within a tube usually formed in the so-called nest by rolling up one side of a leaf, or by bringing together two or three half-devoured leaves, and securely fastening everything with silken threads"; the full-grown caterpillar retreats within, and lines the interior with a thin closely-woven layer of silk.

From this the moth was recorded (in the observations before me, taken in New York State, U.S.A.) to begin to come out as early as June 5th, and that often all had not emerged by July 10th. This date of appearance agrees very nearly with that recorded by Mr. Janson (p. 6), who noted the first appearance of the moths under his special observations on June 8th, and that they continued to emerge in great numbers up to the 20th of the month.

The moth is of a general ashy grey or dark ashy grey colour, and about half an inch or rather more in expanse of the fore wings, which have a broad white band or blotch across them, and have also been sometimes described as having some minute black and lead-blue

* See Report of Entomologist and Botanist in 'Annual Report of the Experimental Farms of Canada' for 1891 (published 1892), p. 195; and 'The Bud Moth,' by M. V. Slingerland, Assistant Entomologist, Cornell University, Agricultural Experiment Station, Ithaca, N.Y., U.S.A., pp. 57–66.

markings at the anal angle of the wing, and likewise near the apex. Three or four days after emerging, the moths are stated to begin laying eggs (mostly at night) on the leaves, which eggs hatch in about a week or rather more, and soon after hatching the caterpillars begin to feed on the skin of the leaf, usually on the under side. A little later the caterpillar spins a tube of silk, usually made alongside the midrib of the leaf, and open at both ends, from which it comes out to feed, and so continues to feed till some time in August or September. Then the caterpillars desert the leaves, and prepare their winter homes by spinning silken cases on the twigs, as previously mentioned, from which (as mentioned, p. 7) they issue forth in spring to attack the opening buds.

This completes the life-history of the whole year, as recorded from observations in Canada and the United States of America, with some small amount of similar observation taken in our own country.

Prevention and Remedies. — The simplest and best remedy, wherever the attacked parts are in reach, is to break off the bunch of infested blossom stems and leaves, which, as above mentioned, may be known by their withered or drooping and *spun-together* state, and to burn these. If this is done before the time comes for the moth to emerge from the chrysalis, a great deal of coming attack will be prevented.

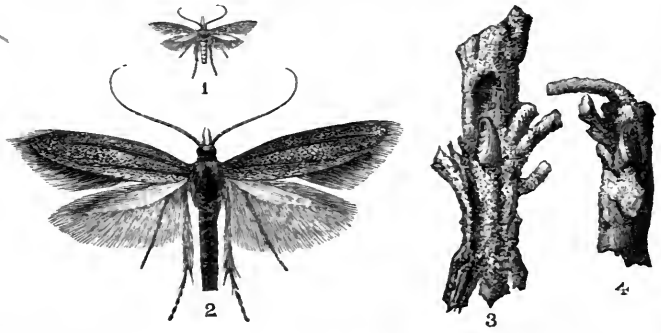
Where the infested shoots are out of reach, and the above-mentioned plan consequently impracticable, the application of arsenical sprays is advised by Prof. Slingerland (see paper quoted in note, p. 7). This, he says, to be of service will necessitate at least two thorough applications *before the flowers open*, and he gives the following recipe:—"If Paris-green only is applied, use about one pound to two hundred gallons [of water], and always add two or three pounds of freshly slaked lime, to prevent the burning effects of the free arsenic in the Paris-green. Take especial pains to thoroughly wet the buds on the smallest twigs. With at least two thorough applications of Paris-green before the flowers open, we believe this insect can be effectively *checked* for the season. Do not spray when the trees are in bloom, as many honey-bees may be killed."—(M. V. S.)

Also, it may be added that spraying when the blossoms are expanded may greatly interfere with the proper setting of the fruit.

Somewhat recently I was informed by a correspondent that the name of Paris-green was not always understood, and that consequently there was a difficulty sometimes in procuring the drug. This difficulty I should have thought would have passed away by this time; but still it may save trouble to mention that Paris-green, Emerald-green, and Schweinfurth-green are different names for the same thing, that is,

aceto-arsenite of copper. The first is the American name, now very generally used in this country and many parts of the world; the second is (or was) the name more especially used with us; the third, I believe, is only used in Germany, or by German traders.

Pith Moth. *Laverna atra*, Haw.; *L. hellerella*, Dup.



LAVERNA ATRA.—1 and 2, moth, natural size and magnified; 3, chrysalis in tunnelled shoot, magnified; 4, chrysalis in bud.

Laverna atra, or the Pith Moth, is a very minute moth, of which the caterpillars probably do a great deal more harm than is generally known of, consequently on their working up the centre of the stems just below the bunches of Apple blossom whilst the buds are still unopened, the cause of the damage not being suspected till the withering of the buds draws attention to an enemy being at work in cutting off supplies of sap.

The infestation has been very rarely reported to me; but in 1889 some notes of its workings in company with the caterpillars of *Tmetocera ocellana*, or Red Bud Caterpillar, were given me,* from his own observations, by Mr. Oliver E. Janson, F.E.S., and in the past year (1898) specimens and observations of injury to Apple leaves and blossom-buds and shoots were sent me, which turned out, on rearing the caterpillars to maturity, to be the work of the "Pith Moth."

The following observations of attack, which proved to be of *L. atra* (from the moth being subsequently reared from the infested twigs), were sent me on June 20th from 21, Cavendish Road, Birkdale, Southport, by Mr. Thomas S. Webster, who wrote as follows:—

"I enclose a couple of small caterpillars which have caused considerable damage to the Apple trees this year. Last year there were a

* See my Thirteenth Annual 'Report of Injurious Insects' for 1889, pp. 81–84.

few, but this year they have been abundant, and many young Apples have withered as a result. I first noticed the creatures by observing certain bunches of leaves drooping in late April or early May, and upon breaking off a twig end, such as I enclose, there was a small reddish caterpillar, which had eaten down the stem to the woody fibre, and up as far as the point where the twig split up into leaves. In no case were the flower-buds injured individually, though of course, where the mischief had progressed, they drooped collectively."

On July 12th Mr. Webster further communicated:—

"I collected a number of the caterpillars, and after keeping these some ten days I discovered a fully-fledged moth in the box this evening."

This moth Mr. Webster forwarded to me, and on comparison with type specimens and descriptions, it proved to be *Laverna atra*, sometimes also known as *Laverna hellerella*.

On June 2nd Mr. C. S. Macklon wrote me from Edric Road, Hatcham Park, New Cross, requesting information as to an infestation in Apple twigs, of which he forwarded me specimens, with the remark that "every year before the bloom of the Apple tree from which these twigs were taken came to perfection it withered up and died off, and the leaves also turned brown and died off; where a little piece was cut off, a maggot was found within." So far as could be judged by the specimens sent without rearing the caterpillars to moth condition, this also was infestation of the "Pith Moth."

On June 27th, and also in July, I was favoured by Mr. O. E. Janson, F.E.S., of 44, Great Russell Street, W.C., with some notes of his own observations, and specimens of damage caused to Apple twigs by this infestation, and also of Pith Moths reared by him from the infested twigs, which are of valuable interest. Mr. Janson mentioned on June 27th that he had found some dead buds (on the Apple trees in his garden near London) which contained a small pupa in an excavated longitudinal central tunnel. These he collected with the view of rearing the moths, and on July 8th Mr. Janson wrote me that he had observed (that morning) that a *Laverna atra* had emerged from the Apple buds, but nothing else at present; * and on July 15th he further mentioned that he had sent me three of the *L. atra* that morning. From these the specimens given life size and magnified at p. 9 are figured.

The moth is only half an inch or hardly so much in expanse of the fore wings. These are narrow, and to the naked eye appear merely of a somewhat varied black or deep brown colour. When moderately magnified, they will be seen to have a very irregular white streak

* In the year 1889 attack of the Red Bud Caterpillar, *Tmetocera ocellana*, had occurred *accompanying* that of *L. atra*.

running along the inner edge of the wing from the base to the extremity, this being of various widths, or having two or three branches diverging towards the middle of the wing. The dark part is more or less varied with tawny, and the light with most minute specks of black; but the great variations of colouring make it almost impossible to describe it serviceably.* In the three specimens before me the right and left fore wings vary from each other to some degree in every instance, as seen by a two-inch object glass. The fringes are grey. The hinder wings are grey, with the fringes paler. The head and face white; the horns (*antennæ*) fuscous, with paler rings.

The specimens sent showed, as figured at p. 9, the change of the caterpillar to the chrysalis condition taking place in the tunnel which it had worked out along the centre of the twig, or at the extremity of it, where the empty case is figured as partly exposed in a destroyed leaf-bud at figure 4. Figure 3 shows another specimen lying amongst the "frass," caused by its working in the tunnelled twig. The chrysalis was about three-sixteenths of an inch long, and the sheaths of the antennæ remarkably noticeable. The caterpillar was of a reddish or brownish colour; but I am unable to give the details, consequent on illness at the time being much in the way of my own observations, and also, after much search, I have been unable to find a detailed description of the larva of this species of *Laverna*.

The description of the habits of the larvæ, as given by Herr Mühling,† is that they hybernate under the bark of an Apple twig close by a bud. In May they bore onwards into the young growing shoot, and feed on the pith (whence the name of Pith Moth). They also eat up the middle of the stem beneath the bunch of flowers, and thus cause the budding blossoms to wither and perish, even to the extent of the destruction of the whole bunch.

Comparison of these notes with those of our British observers mutually confirm each other, and attention of Apple growers should especially be given to the *distinguishing* characteristics of this infestation being that the larva or caterpillar feeds within the stem, and there or at the tip of its working, partly exposed in a leaf-bud, it turns to the chrysalis state. Thus, from cutting off the food supplies, the cluster of Apple buds perishes; but, as noted by Mr. Webster at p. 10, I do not know of any instance being recorded of the flower-buds being "injured individually," though of course where the mischief has progressed "they droop collectively."

* For minute description of what is considered the ordinary marking, with notes of some differences of colouring, see Stainton's 'Tineina,' pp. 239, 240.

† See observations by Herr Mühling quoted in 'Praktische Insektenkunde' of Dr. E. L. Taschenberg, pt. iii. p. 287; and 'Die Pflanzenfeinde' of Herr Kaltenbach, p. 781.

Thus the attack may be distinguished from that of the Red Bud Caterpillar of *Tmetocera* (=*Hedya*) *ocellana*, or Eye-spotted Bud Moth, of which an account will be found in the preceding paper. In this case (that of *T. ocellana*), though the caterpillars at times tunnel along the centre of the shoot, they work in the opening leaf- and fruit-buds, and presently tie the central leaves and flowers together with silken web, in which they turn to the chrysalis state; in summer, it is stated, the newly-hatched caterpillars may be found feeding on the lower side of the leaves.

It is said by Heineman that the caterpillars of *L. atra* live in autumn in the fruit of *Cratægus;* and Stainton * also says,—"Larva in hawthorn berries in September; the black variety in budding shoots of Apple in February and March."

Prevention and Remedies. — These appear solely to consist in cutting off ends of twigs where, by the withering away of the Apple blossoms, the presence of the attack is observable, and burning these, so as to destroy the infestation within before it has passed to the moth condition, and can fly abroad to set new mischief on foot.

Small Ermine Moth. *Hyponomeuta padella*, Linn.

Hyponomeuta padella.—Small Ermine Apple Moth, caterpillar, and cocoons, life size; and caterpillar, much magnified.

Amongst the leafage attacks regarding which inquiries were sent in the course of the past season were those of the caterpillars of the "Small Ermine Moth," which have been so often referred to before that it would not be necessary to notice them again, but for a successful method of getting rid of them on no less a scale than when stripping the leaves of seventy yards of a Hawthorn hedge having been communicated to me too late for insertion in my 'Handbook.'

* Stainton's 'Manual of Butterflies and Moths,' vol. ii. p. 398.

The life-history of the infestation, put as shortly as possible, is that the little moths lay their eggs in patches on twigs of the attacked trees, chiefly on Apple or Hawthorn, from which the caterpillars may be found hatched by the beginning of October; these live through the winter, but attention is usually first drawn to their presence in spring or early summer, when they may be found feeding in large numbers on the leaves, and spinning web-nests, in which they shelter in companies. When full-fed, the caterpillars each spin a separate cocoon of light texture in the web shelters (see figure, p. 12), within which they turn to the chrysalis condition, and from which the moths come out about the end of June.

The caterpillars when first hatched are about one-twenty-fourth of an inch in length, yellow in colour, with black heads; they afterwards turn to a dirty ash (or possibly pale ash) colour, spotted with black; and when full-grown, the ground colour is of a dirty yellow or lead colour.

The moth is of the size figured, with rather narrow fore wings about three-quarters of an inch in expanse, and usually livid or whitish dotted with black, the hind wings livid or lead colour; but the tint is very variable. The species or variety figured at p. 12, of which the fore wings of the moth have the black spots on a pure white ground, and of which the cocoons are opaque, was at one time especially distinguished as *Hyponomeuta malivorella*, or Small Apple Ermine Moth, and was considered more especially to frequent the Apple. But however this may be, there does not appear to be any difference in the life-history requiring different treatment.

Prevention and Remedies.—The usual remedies for this attack where the infested boughs are so clear of each other that the webs can be cut off are well known. Then the web-nests should be cut off, when the caterpillars are within, and allowed to fall into a pail of any fluid held below which will prevent them escaping. Or the caterpillars can be shaken down to some extent by jarring the infested boughs, and destroyed; or syringings with soft-soap and a little paraffin oil mixed with it answer well; or even, where there is a good water supply, *thorough hard* washings sent at the tree of water without any admixture I have known to clear the tree very effectually. It was not, however, until the past season that I had an instance of treatment being successfully carried out on a long length of tall hedge.

On July 5th the following communication, with specimens of *H. padella*, with larvæ (some full-grown), and some pupæ spun up side by side in the manner figured at p. 12, were sent me from The Rectory, Caterham, Surrey, by the Rev. Fred. A. Bright:—

"I am advised to send for your inspection specimens of a quickset

hedge taken from my glebe. The blight commenced on Sunday, June 26th, and in three days about seventy yards of the hedge was devoid of foliage. The hedge is six feet high, and very thick; it is the work of millions of small caterpillars, as you will see by the specimens. I had the hedge syringed with soft-soap and water, which seems to have good effects; but in places the blight is still going on. What is it, and what is the best remedy? . . . The blight appears to be confined to my premises, with the exception of a hedge on the other side of the road."—(F. A. B.)

In reply to Mr. Bright's inquiry, I wrote, on July 7th, as follows:—

"In the present case the remedy which is being applied of syringing with soft-soap in water is very good, but a *little* paraffin oil well stirred into it would make the mixture more effective. . . . Only it must not have enough paraffin or mineral oil added to burn the tender bark, and the mixture should be so constantly stirred as to keep the oil and soft-soap wash thoroughly incorporated."

On August 13th Mr. Bright was good enough to tell me that on returning, after an absence from home, he found that the remedy I had suggested had been in every way effectual, and the hedge was as green as ever, with a superabundance of foliage. Further, on October 1st, in reply to an inquiry I sent, Mr. Bright mentioned that the application of the soft-soap and a *little* paraffin oil had been "a great success."

The success of this broadscale application seems worth recording, as it is one that can be carried out at no great cost, either for material or labour; and, so far as I am aware, we have not previously had any note sent of definite treatment for getting rid of these caterpillars as hedge-leafage pests.

If the application of the kerosine emulsion so much used against leaf-feeding caterpillars in the United States of America and Canada should be preferred, the following recipe, which is one published by the Department of Agriculture of the United States of America, will be found serviceable. In this the plan is to add one gallon of water in which a quarter of a pound of soft-soap (or any other coarse soap preferred) has been dissolved, boiling or hot, to two gallons of petroleum or other mineral oil. The mixture is then churned, as it were, together by means of a spray-nozzled syringe or double-action pump for ten minutes, by means of which the oil, soap, and water are so thoroughly combined that the mixture settles down into a cream-like consistency, and does not, if the operation has been properly performed, separate again. This is used diluted with some three or four times its bulk of water for a watering; if required for a wash, at least nine times its bulk is needed—that is, three gallons of "emulsion," as it is termed, make thirty gallons of wash. Warning is given that care

must be taken with *each new crop to ascertain the strength that can be borne by the leafage, and this equally applies to all applications to live bark.*

This point of testing the strength that can be borne by different kinds of leafage and by leafage in different conditions is exceedingly important, and so also is the matter of the soft-soap and the mineral oil being so *thoroughly incorporated* that they will not separate. If they do, the mineral oil will be sure to cause much injury to the leafage on which it may fall without being diluted by the soft-soap mixture.

Note.—Besides the above-mentioned attacks, inquiries or communications were received regarding almost all the commonly injurious Apple infestations, as, for instance, the American Blight, *Schizoneura lanigera;* Apple Aphis, or Green Fly, *Aphis mali;* Apple Mussel Scale, *Mytilaspis pomorum;* Apple-suckers, *Psylla mali.* Also the Apple-blossom Weevil, *Anthonomus pomorum*, and the Clay-coloured Weevil, *Otiorhynchus picipes*, which was unusually troublesome, and is noted under the heading of "Hops." The Codlin Moth, *Carpocapsa pomonella*, was, almost as matter of course, present. In fact, with the exception of the Apple Sawfly, *Hoplocampa testudinea*, almost all the ordinary infestations were noticeable; but as they have all been entered on in detail before in previous Annual Reports, or in my 'Handbook of Orchard and Bush-fruit Insects,'* it has seemed unnecessary to allude to them again, excepting a few words about the two following occasional infestations.

The great caterpillars of the Lappet Moth, *Gastropacha quercifolia*, which have been very rarely reported as injurious to orchard leafage, appeared again in May on Apple, and in a new locality, near Winchcombe, in Gloucestershire. These caterpillars are easily observable by their great size, being as much as upwards of four inches long. The colour is greyish or brownish, with a row of more or less observable markings down the middle of the back, these marks being sometimes of a dark V-shape. The caterpillars are fleshy, cylindrical, somewhat hairy, with a row of fleshy protuberances along each side just above the feet, to which the name of "lappets" has been given. The cocoon in which the change to chrysalis takes place is spun in any convenient shelter, and from these the moths, which are of a rich brown ground colour, and may vary in size (in male and female respectively) from two to three and a quarter inches, may come out from May to August.

* London: Simpkin, Marshall & Co. 1898. Price 3*s.* 6*d.*

The caterpillars appear to winter in partly-grown condition extended along a twig of their food-plant, and as they attain maturity are excessively destructive, clearing the leaves wholly away down to the very footstalk.

The best remedy is hand-picking.

The caterpillars of the "Eyed Hawk Moth," *Smerinthus ocellatus*, are of a green ground colour, with the skin rough, dotted with white, and having seven white stripes slanting backwards at the top on each side, the seventh stripe being continued up the horn-like process at the tail extremity of the caterpillar, which is pink whilst the caterpillar is young, and afterwards changes to pale or sky blue, with a greenish or black tip. These are sometimes three inches or more in length.

The caterpillars are at times exceedingly destructive to Apple leafage, and when full-fed turn to a red brown chrysalis a little below the surface of the ground, from which the large and handsome moth (which is of a rosy brown or ash colour on the fore wings, and has a large eye-like spot in the centre of the hinder wings) comes out during the following summer.

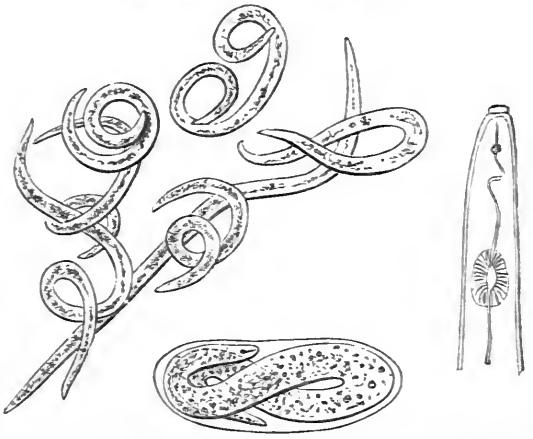
The best remedial measures are hand-picking, or jarring down the caterpillars, or skimming off the surface soil with the contained chrysalids during the winter.

This attack will be found entered on in detail in my Eighteenth and Nineteenth Annual Reports; and that of the Lappet Moth in my Seventeenth and Eighteenth Annual Reports, and also in my 'Handbook,' with life-size figures of the large moths and caterpillars.

CLOVER.

"Stem-sickness" caused by **Stem Eelworms.**

Tylenchus devastatrix, Kuhn.



TYLENCHUS DEVASTATRIX, Stem Eelworms.—Anterior portion of female showing mouth-spear; and embryo in egg; all greatly magnified: anterior portion magnified 440 times. From figures by Dr. J. Ritzema Bos.

In the course of the year 1897, "Tulip-root" appeared to be more than usually prevalent in the Oat crop, and during the early part of 1898 much more inquiry was sent than is generally the case as to the cause of the serious failure of Clover in various parts of the country. Whether there was any connection between the attacks I cannot tell, but in a large proportion of the cases in which specimens of diseased Clover were sent to me for examination, I found them to be suffering from infestations of the "Stem Eelworm," *Tylenchus devastatrix*, which also cause much mischief by giving rise to the attacks known as Tulip-root and Segging in Oats.

The dates of inquiries in the past season (1898) ranged from January 26th to April 4th, and were from various parts of Yorkshire and Lincolnshire; likewise from localities near St. Ives, Hunts; Peterborough, Northamptonshire; Hollesley Bay, Suffolk; Rochford, Essex; Edenbridge, Kent; and Malvern, Worcestershire.

In almost every instance specimens of the diseased plants were sent for examination, and in about three cases I found outside the roots some amount of the white maggots of the well-known Clover and Pea Leaf Weevil (*Sitones*, scientifically), which sometimes do much harm at Clover roots, but (in the above instances) were far too few in number to account for the serious amount of mischief present. These

larvæ were about a quarter of an inch long at full growth, plump, wrinkled, legless, and with a horny brownish head furnished with strong jaws.

In a single instance I found presence of the "Red Maggot" of the Clover-leaf "Gnat Midge," *Cecidomyia trifolii*, which are of very similar size, shape, and colour to the well-known "Red Maggot" of Wheat; but here also, both from what has been observed of their habits, as well as the very limited amount of their presence, there was no reason to suspect them of causing the mischief.

Besides the above, there were various other presences, as of worm-like larvæ of two-winged flies, young earthworms, or allied annelide worms; also the small knob-like growths, or galls, so often found on the roots of Clover and other leguminous plants, were inquired about, but in no case could the injuries be attributed to any of these.

Above ground the case was different. There was some amount of fungoid presence, as well as very much of "Stem-sickness," demonstrably caused by presence of the Stem Eelworm, *Tylenchus devastatrix*, and as the characteristics of the two attacks are completely different it cannot fail to be of use to give the following short notes from the official Reports of Mr. W. Carruthers, F.R.S., Botanist to the Royal Agricultural Society,* as conveying most valuable information as to the characteristics and prevalence of the fungoid attack.

In his Reports (noted below) Mr. Carruthers mentioned the injury to Clover caused in many parts of the country by the parasitic fungus *Sclerotinia trifoliorum*, with the observation in his Report of April 6th that "throughout the middle and south of England the destruction of Clover by this parasite has been very serious." With the returning growth, however, the presence of the pest to a destructive extent seems to have passed away, as in Mr. Carruthers's Report of May 25th he mentions that "no case of active injury has been observed during the month."

The description of the characteristics of this fungoid attack, from which I extract a few of the main points (given in Report for February, p. xxiii), is well worth notice as showing at a glance the distinctions in appearance of the Clover growth when suffering respectively from this fungoid disease, or the deformed growths caused by presence of the "Stem Eelworm."

This parasite (*Sclerotinia trifoliorum*) shows itself by the dark, almost black irregular-shaped spots on the leaves. "These are the spores of the fungus. . . . The mycelium, or roots, of the fungus pushes its way through the parts of the plant above ground, killing

* See Reports of Consulting Botanist for February, March, April, May 4th, and May 25th in Parts II. and III. of 'The Journal of the Royal Agricultural Society for 1898.'

them and reducing them to a wet disorganised pulp." Other details, as well as observations of another fungoid attack (*Peronospora trifolii*), are given; but I quote the description of the method of destruction of leafage by the widely spread *S. trifoliorum* as being completely different from the *characteristically* deformed growth of buds and shoots, which unfortunately we have had only too much opportunity of knowing for some years back as the effect of the infestation of *Tylenchus devastatrix*, or Stem Eelworm.

I also have much pleasure in adding a few lines I was favoured with by Dr. J. Ritzema Bos, Director of the Phyto-pathological Laboratory at Amsterdam, relatively to information he had given me when I had the advantage of some conversation with him here early in the year:—"I said that in Holland I often found a very dangerous Clover-sickness caused by the fungus *Sclerotinia trifoliorum* (=*Peziza ciborioides*). This Clover-sickness is in Holland much more common than the Clover-sickness caused by *Tylenchus devastatrix*. It sometimes occurs that both diseases attack the same plant. *T. devastatrix* causes an abnormal growth, and can cause *at length* the death of the Clover plant; *Sclerotinia trifoliorum* causes the death of the plant after some days."—(J. R. B.)

In by far the greatest number of samples of injured Clover sent to myself, mischief was demonstrably to be attributed to Clover Stem-sickness, caused by *Tylenchus devastatrix*, or Stem Eelworm, as shown by the peculiar form of diseased growth to which this infestation gives rise, and also by the presence of Eelworms in the diseased shoots and buds.

The Stem Eelworm is a minute, transparent, white "threadworm"; when full-grown, only about one-twenty-fifth of an inch (about half a line) in length, and its greatest breadth is about one-thirtieth of its length. The very small white worms often seen at the roots of plants, which may be worm-like fly larvæ, or very young "earthworms," or nearly allied to them, are sometimes mistaken for *Tylenchi;* but these may be a quarter of an inch or more in length, and the fact that they *can be observed* without difficulty by the naked eye shows at once that they are *not* "Stem Eelworms."

The figure at p. 17 shows the general appearance of *Tylenchus devastatrix* when much magnified, and the right-hand figure shows a special characteristic of the *Tylenchi*, of presence in the *œsophagus* (or "gullet"), by which they suck in their food, of a sharp needle-like process, called the spear, placed on a bulb-like base, which, when much more magnified, will be found to be *trilobed*. There is also in the case of this species a characteristic distinction in the structure of the male; but as the greatest length of these wormlets is only about one-twenty-fifth of an inch, these distinctions, which are only

observable with the help of high microscopic powers, are of little service for general use. The wormlets propagate by egg-laying, and may be found in egg and young state and also as fully-formed males and females together in the misshaped stems and leaf-buds of the infested Clover.

In the case of Clover "Stem-sickness" in the early part of the year, the circumstance of the stalks and branches being shorter and thicker than in healthy growth is characteristic of attack, joined to the altered state of the buds themselves, which may be found much thickened in shape; often a number of them growing solitarily on the crown of the plant being of an irregularly enlarged and prolonged oval or bulb-shape. When attention is drawn to the attack in its winter condition, probably many or most of the above-described form of buds and of the diseased shoots and branches will be found to be dying or decaying; but where the mischief is not so far advanced, the Stem Eelworms may be found both in young and mature state in the plants.

In summer the characteristic malformations are much more fully developed, and, as late as when the flowering-heads are still present, attacked growths may be found in the form of short barren shoots about an inch long, of oval shape, and with the leaf-growths distorted so as merely to overlap each other, and form a kind of tile-like imbricated exterior. These shoots are placed close together, and, where I have seen them, as many as five grew on an inch length of stem, one at the end, and two on each side, so as to form a flat fan-like mass. The shapes varied; they were commonly irregular, and oval, and somewhat bulb-shaped, or much prolonged, and sometimes the lower part of the flowering stem was enlarged for an inch or two at the base. In various of these shoots I found the Eelworms present up to numbers which might be described as "swarming" in the palish brown powdery, or rather granular, matter in the hollow near the base, or other parts of the perishing shoots.

But it is usually the spring or rather the winter condition of which samples are sent me for identification; and in the past year the first inquiries were sent me in the last days of January as to great damage that was being done to Clover, *stated* to be by grubs sent. These were larvæ of the Clover-leaf Weevil (*Sitones*), but I saw no reason (from so much information as was sent me) to attribute the mischief to these grubs, and on examining samples of the diseased plants sent me on February 3rd, from Skirbeck-Quarter, Boston, by Mr. G. Rainey, I found them to be suffering from Eelworm Stem-sickness. There were the long misformed buds and deformed shoots (now brown) which are characteristic of this attack, and within these, where I examined, Eelworms of different degrees of development were numerously present. These were, when I began examination, torpid, but the youngest

specimens soon began to recover power of active movement in the warm room, and likewise some of the older specimens, whilst I continued examination. The Clover was the "Common Red Clover," *Trifolium pratense*, but the seed was mixed of two different kinds, about two-thirds "English Red," and one-third "Russian Red," and sown in the preceding April "in the usual way in a corn crop."

On February 14th, specimens were sent me by Mr. Arthur Alsebrook, from the Yorkshire College, Leeds, of diseased Clover plants and maggots, which proved to be (as above) of *Sitones*, or Clover-leaf Weevil, with the observation that he considered the larvæ appeared to be the cause, in the East Riding of Yorkshire at least, of the dying off of the Clover, "which is so prevalent throughout many parts of the country." On examination, I found that, besides the weevil maggots, there was Stem Eelworm attack, but only a few of the Eelworms noticeable, for the samples of diseased growth sent were very small.

On the 18th (that is, four days later) Mr. Alsebrook wrote to me again, requesting my opinion on a series of specimens of Clover, of which he wrote:—

"They are all from the same district (near Howden, in the East Riding), and were taken by me yesterday and to-day.

"No. 1 had many weevil larvæ in it, which I have kept.

"No. 2 has many thread-like worms, of which I should be glad of particulars.

"No. 3 has at the roots of one plant some very peculiar growths, which I should also be glad to have particulars of."—(A. A.)

These specimens I examined, and in the case of "No. 1," from which "many weevil larvæ" had been taken, I did not find that there was injury attributable to *Sitones* maggots, but there were live Eelworms present in the stem part of the abortive bud examined.

"No. 2," small worm-like creatures, from size, shape, and presence of a brown head with two antennæ, presumably a species of *Sciara* (a two-winged fly), and feeding on decayed matter.* Eelworms of different sizes present and in active condition. The red maggots of a *Cecidomyia*, or Gnat Midge, were also present. These little larvæ are legless, cylindrical, pointed towards the head end, and are especially recognizable by having beneath the body (near the head) a horny organ, known as the "scraper" or "anchor process." This consists of a narrow stem, of which one end is fixed to the larva. The other end, which is free, and enlarged, and points forward, varies much in shape; sometimes it is bifid, but in the present case is widened and prolonged in the middle into a somewhat flattened triangular shape. The maggots consequently were presumably larvæ of the Clover-leaf Midge, *Cecidomyia trifolii*, now in hybernating state, which, when in

* See 'Farm Insects,' by John Curtis, pp. 460, 461.

active condition, infest the lower leaves of Clover, fastening them so that the bent edges fit together into a shape like a little pod, within which the maggots feed and change to pupæ, from which the little two-winged Gnat Midges, which may be generally described as of some shade of brown, presently develop. The maggots may be very easily recognized by their resemblance to the common Red Maggot of Wheat.

In 1889, similar specimens were sent me from diseased Clover at Woburn; and on April 3rd in that year, Prof. Herbert Little sent me specimens from Clover roots near Wisbech. I had them also from Rothamsted, and also from Chelsing, near Ware, in connection with Stem-sick Clover; but I could not find that in any instance they were doing more than sheltering in, or *possibly* feeding on, the decayed matter of the dead root or bark. I did not in any case find them feeding on living stems, and as in the case of experiments at Rothamsted the "red maggots" were still to be found at Clover roots after the plants had been thrown into vigorous growth, it did not appear likely they were the cause of damage.

"No. 3" of Mr. Alsebrook's inquiries referred, on examination of his specimens, to the little knobs or gall-like growths which are so often to be found singly, or in small numbers together, on the roots of Clover, Pea, Bean, or other leguminous plants. Other inquiries as to other presences in the Clover were sent, but do not require special notice.

On February 25th I received some very characteristic specimens of winter condition of Stem-sickness in Clover from Mr. M. A. Streatfield, of Chested, Chiddingstone, Edenbridge, Kent, with the following observations, amongst which it will be noticed that the infested field was in Oats in the previous year, which might bear importantly on the matter:—

"I am sending you some Clover plants from a field where the Clover is rapidly dying in patches. Is it the effect of Stem Eelworms, and do you think the attack is likely to increase? The plant on the whole is wonderfully strong and healthy. The field was Oats last year, manured with guano. . . . P.S.—I find small white maggots among the roots of every plant, but I do not think they are injurious."

On February 27th Mr. Streatfield wrote further:—

"Might I ask if you have any experience as to the action of sulphate of potash, whether it is injurious to the Eelworms, or merely stimulates the weakly plants? It is rather a big expense to top-dress the whole field, but bad patches might easily be treated.

"Also whether Oats from a Tulip-rooted crop would be likely to spread the disease if used as seed?

"I may add that the Clover field in question is sown with Red

Clover, Trefoil, and Rye Grass, and that at present only the Trefoil plants seem affected. A field of my neighbour's, sown entirely with Trefoil (the same seed as mine), is nearly half spoilt."—(M. A. S.)

In regard to Mr. Streatfield's inquiries, firstly, as to effect of sulphate of potash. I am not aware of any series of experiments having been instituted to trace disappearance of the Eelworms from the infested plants. But we know that the diseased growth soon ceases, and likewise that where the sulphate dressings (mentioned further on) are given at sowing time, this kind of sickness has not appeared, or slightly; therefore it has seemed to me safe to consider that the dressings have a definitely injurious effect on the wormlets, as well as helping the plant against them by increased luxuriance.

Secondly, whether Oats from a Tulip-rooted crop would spread the disease if used as seed? There is no reason to fear this; but litter formed of parts of the Oat-straw in which the wormlets harboured would be *very likely indeed* to carry the disease to any crop liable to infestation to which such litter was taken.

The following observations regarding Clover perishing from some cause unknown to the sender were forwarded to me, together with specimens of the attacked plants, on February 18th, from The Walnut Trees, Bluntisham, St. Ives, Hunts, by Mr. Tebbutt:—

"I forward with this specimens of Clover plants which are suffering from some cause unknown to the farmers in this locality. I have two fields of about thirty acres, on which I think two-thirds of the young Clover plants are destroyed. These young plants are in envelope No. 1. In No. 2 are two or three specimens, also affected, of Clover two or three years old. Some plants are apparently still fading away. In some I think (doubtfully) there are signs of a fresh shoot, but generally the plants affected seem to be quite destroyed.

"All the fields of yearling Clover (sown in the spring of 1897) are, so far as I can learn, seriously affected.

"At first many persons thought the cause was 'Clover-sickness,' but fields that have not been Clover for a long period are affected.

"I have seen some small worms on the decayed plants, but I do not at all know whether they were the cause or the effect of the decayed plants.

"The decayed plants in envelope No. 2 are from fields of two or three years old Clover, but in these fields the decayed plants are rare."

In No. 1 packet there were but few characteristically deformed shoots, and no Eelworms, so far as I could ascertain, were present; but on the large old plant in No. 2 packet I found distorted enlarged buds and short shoots, in which live Eelworms were present.

The presence of Eelworm Clover-sickness on fields which have not been in Clover for years may easily be caused by other crops liable to

the Eelworm infestation having been on the ground, or manure having been used from infested litter; but if specimens of the plants of field No. 1 had been submitted to an expert in fungoid disease, in all probability some one or other of the kinds of fungus, or mould, of which Mr. Carruthers noted the prevalence, would have been found present.

On February 28th, Dr. Robert Johnson, Director of the Colonial College, Hollesley Bay, Suffolk, when communicating with me on some other subject, added :—

"While writing (at this moment) the enclosed have been brought to me; I have not examined them. To the naked eye there would appear to be some fungus. I send them to you just as they are, in case they may be interesting. The message brought to me is—'There are some acres going off like this.' "—(R. J.)

In this case (and looking only to the points on which I was qualified to offer an opinion) I found some small brown shoots present similar in form to those in which I have lately found Eelworms in diseased Clover. As mentioned above, I did not trepass on the field of fungoid identification, in which I am not skilled.

On March 5th, Mr. Henry Howman, Director of Agriculture of the Agricultural Sub-Committee, Gloucestershire County Council, wrote me as follows from Gloucester:—

"I have had numerous complaints from farmers for some time past that their Clover plants are dying without any apparent reason, and on all kinds of soils—stiff and light soils. I venture to send you some plants from a stiff land. You will notice the leaves are going rotten, as if they were damping off. . . . The dying plants are not in patches, but here and there."

The plants of Clover sent in most instances had some very vigorous shoots, but also in some instances one or two, in some approximately six to a dozen, abortive brown shoots, precisely similar in shape to those in which I have lately found presence of Eelworms; and in this instance also Eelworms were present in some of the abortive shoots. Presumably (from Mr. Howman's observations) this also was a case of coincidence of presence of Nematoid worm and fungoid attack.

On March 23rd, Mr. John Crisp, writing from the Estate Office, Elton Hall, Peterborough, mentioned having lately found white maggots amongst the Cow-grass on the estate, and sent me specimens, which turned out (as in some of the other cases observed) to be maggots of the Clover and Pea-leaf Weevil (*Sitones* of various species), of which the perfect beetles not unfrequently do widespread damage at the leafage in spring or summer, and the maggots are to be found at the roots in winter, by which they turn to the chrysalis condition in the earth, and from this state the beetles develop towards the beginning

of summer. But though sometimes the maggots do a deal of harm at roots, I am not aware that they were in fault in this case.

An account of a large quantity of a good plant of Clover dying off in a most unusual manner at a locality near Malvern was not accompanied by specimens which gave opportunity to identify the attack satisfactorily.

The latest inquiry which was forwarded was sent me by Mr. E. Wightman Bell, F.C.S., from High Bridge, Spalding, on April 4th, with a specimen accompanying, and the observation that I was no doubt aware that the Clover crops were dying off to a very great extent, and he would be glad to know if the pests forwarded were the cause; also that it was to be noted that the more solid portions of the fields have not suffered as much as the lighter, and the same applies to those fields which were well trampled by sheep.

The specimens sent showed presence of Stem Eelworm Clover-sickness; but it is well worth note that in a further communication, Mr. Wightman Bell, who is well qualified to report on the subject, mentioned that in almost every case he had observed *mycelium* threads on the leaves of affected Clover.

A summary of the reports sent of the widespread prevalence of Clover disease during the early part of last year (1898) shows, from the observations of Mr. W. Carruthers in his official Reports to the Royal Agricultural Society, that there was great destruction by "sickness" due to fungoid presence, especially that of *Sclerotinia trifoliorum;* and from reports and specimens sent to myself there was also, I found, a great prevalence of sickness caused by presence of Stem Eelworm, *Tylenchus devastatrix*. These two attacks may occur separately or coincidently, and in some of the attack of which specimens were especially observed, as in those above noticed reported on by Mr. Wightman Bell, both the fungoid and Nematoid infestations appear to have been present.

Other infestations, as of weevil maggots (larvæ of *Sitones*), and of Clover "Red Maggots" (larvæ of *Cecidomyia trifolii*), were present; and the first of these is known to do mischief at times at roots of Clover, though, so far as I am aware, it has not been recorded as often causing much damage. The Cecid larvæ (the "Red Maggots") may fairly be presumed to be harmless, as we find them in the *decayed* matter of the roots, also we have *no* evidence of their feeding on the living tissues in their winter subterranean conditions, and also we know that when the maggots are in active state in summer they have a peculiarly distinctive method of feeding,—that is, by fastening the edges of the selected Clover leaf together, and within this shelter feeding and turning to the chrysalis state.

Specimens of other kinds of presence—such as insect larvæ, small

worms, galls on the roots, &c.—were sent or referred to, but there was no reason for supposing any of these to be doing harm.

It would save a deal of trouble, and likewise delay in applying proper remedies, if two points regarding signs of Eelworm Stem-sickness were more thoroughly known.

One is that if the minute white worms or worm-like creatures so often seen about the roots are perceptible to the naked eye, this very circumstance shows that they are *not* Stem Eelworms. These are only one-twenty-fifth of an inch (or about half a line) in length, and if any reader will take the trouble of trying to mark this amount of an inch on a foot rule, he will be at once convinced how impossible it is to notice a presence of worms of only the above length, and of only a thirtieth part of the breadth, without magnifying powers.

The other point is that the Stem Eelworm attack is the *only one* of all those noticed in the preceding pages which is characterized by a definitely deformed kind of growth of shoots and buds, and observation of this very peculiar nature of growth whilst still it was living and open to the application of means of prevention and remedy would probably save much loss.

Prevention and Remedies.—Observations on the nature and treatment of Eelworm infestation will be found entered on in my Annual Reports mentioned below.*

In the Tenth Report, besides considerations regarding the infestation itself, valuable directions by Dr. Julius Kuhn as to eradicating the pest by special cultivation of the ground and avoiding of infested manure will be found.

In the Eleventh Report notes are given of this *T. devastatrix* as infesting Carnations, Clover, Oats, Rye, and Wheat, but *not* found to infest Barley; and at p. 70 various common grasses, weeds, &c., are named which have been found liable to infestation.

In the Twelfth Report are special notes of successful use of sulphate of potash and other dressings.

In the Thirteenth Report I give, by permission of Dr. J. Ritzema Bos, to whom I have been constantly greatly indebted in the course of my observations for identification of species and other valuable assistance, a full-page plate,† with figure of the male and also the female of *T. devastatrix* magnified 200 times, and of the anterior portion of one of these wormlets magnified 440 times, with magnified figures of eggs, &c., and explanation of plate accompanying. Details are also

* See Tenth to Fourteenth Annual Reports of Observations of Injurious Insects, also Eighteenth, Twentieth, and Twenty-first Annual Reports.

† See Plates I. and II. in 'L'Anguillule de la Tige (*Tylenchus devastatrix*, Kuhn),' par Dr. J. Ritzema Bos, Prof. à l'Institut Agricole de l'État à Wageningen (now Director at the Laboratory of Phyto-pathology at Amsterdam).

given, amongst other points entered on, of various applications found successful at Rothamsted in checking Eelworm Clover-sickness and pushing on good growth.

In the Fourteenth Report, special account of this attack as affecting Field Beans, with identification by Dr. Ritzema Bos of *T. devastatrix* as the cause of the stunted and deformed growth, and life-size figure of one of the attacked plants.

In the Eighteenth Report, the discovery by Prof. J. Percival (of the South-Eastern College, Wye, Kent) of presence of Eelworms showing no apparent specific distinction between them and *T. devastatrix*, and found by him in Hop roots, is mentioned. This is a matter of much scientific interest relatively to the position of the wormlets being not in the stem or buds, or modifications of those parts, but in the roots. Regarding this infestation Dr. Ritzema Bos, to whom specimens were submitted, observed:—

"I found in the larger parts of the roots which Prof. Percival sent me, in the cortex close to the bast, Nematoid worms closely allied to, if not identical with, *Tylenchus devastatrix*. I never found *T. devastatrix* in roots, always in stems and leaves (also in subterranean caulomata and phyllomata). . . . The *Tylenchus* in *Humulus* roots is somewhat smaller than *T. devastatrix*, but as this species varies much in length, that would be no cause why it should not be *devastatrix*. . . . The *Tylenchi* in the Hop roots are smaller than the *T. devastatrix* in other plants, but the maximal length of those of Hop roots surpasses the minimum length of *Dipsacus* (according to Kuhn: I myself never found so small ones), and as I cannot find any other constant difference between the Hop-root *Tylenchus* and *T. devastatrix*, we may say that the Hop-root *Tylenchus* must indeed belong to this species. It is the first time that I find *T. devastatrix* in the roots; I always found it in the stems and the leaves only. It is curious that I found in the Hop roots a very large number of males, also larvæ, but only a very small number of females."—(J. R. B.)

Other observations on the subject by Dr. Ritzema Bos, and communications with which I was also favoured by Prof. Percival, will be found in the same paper.

In the Twentieth Report, detailed observations will be found—pp. 107–115—on the misshapen swelled and cracked growth of Onions, caused by infestation of *T. devastatrix*, or Stem Eelworm. This "Eelworm-sickness" has been known for about twelve or more years as injurious to Onions in Holland, but has not been reported as present in this country until 1896, in which year full observation of the characteristics of the damaged bulbs and swelling of the flag or leaf above the bulb were sent me, and I also found the attack present, so as to be able to study it, in my own garden.

In the Twenty-first Report "Eelworm-sickness" is again alluded to, consequently on its prevalence in that year, or at least observations regarding its presence, as causing Tulip-root in Oats, beginning on May 6th and continuing at intervals during the summer from widely separated localities, from as far north as Pincaitland, Midlothian, N.B., to Chested, near Edenbridge.

In the above-named Reports accounts will be found of (I believe) all the attacks to different kinds of crops which have been found from 1886 onwards to be subject in this country to injury from presence of *T. devastatrix*, with description of the characteristic appearance of the deformed growth due to the presence of this Stem Eelworm, so as to enable observers to distinguish almost at a glance the nature of the mischief that is going forward.

With the advance of information as to measures of successful treatment, or of measures which *cannot* be trusted to, or any other points, whether of cultivation, habits of the Eelworm, or observations bearing serviceably on the subject, these have been successively added. Also, to save trouble in reference, the technical description of the Eelworms has been frequently repeated, and occasionally also a full-page plate of the male and female Eelworm, greatly magnified, for use of which, as well as for identification of specimens and much valuable information, I am greatly indebted to the kind help of Dr. Ritzema Bos, the well-known observer and writer on these Nematoid worms, whose assistance in permitting inquiry, as well as by reference to his published works, I have gratefully acknowledged throughout the observations.

The methods both of prevention and remedy of the attack have gradually become well known, and are given in the above-mentioned Annual Reports in details, with the reasons of treatment based on the habits of the wormlets, and with the names of the observers appended; but the following notes of the main points are repeated as matter of convenience.

In regard to method of infestation and prevention of spread of it in the land.—A large proportion of the Eelworms leave the plants when dying and *drying* (as in Oats, for instance), and go into the surface soil, but some remain in the plants. To get rid of those in the land, common ploughing or digging is of very little service, it only disperses them about. But ploughing with skim-coulter attached, or trenching, will bury them well away. Those that remain in the plants will be in the stubble, or parts of the infested crop left in the field, or will be carried off in the harvested crop to be used for bedding or fodder. In the first case, as much of the stubble or remains of the infested plants as can be collected should be gathered together and burnt. With

regard to what is carried from the land, it should be borne in mind that if it becomes mixed (as in litter, for instance) with manure, the Eelworms will in all probability be carried out again to reinfest the fields. It should also be remembered that they may be carried to an amount to do mischief in such surface earth of the infested field as may cling to the boots of workmen, or agricultural implements or garden tools. In this manner *patches of infestation* are very liable to be formed and spread.

All measures, whether of treatment of the ground or of liberal and rich manuring, of a nature suited to drive on hearty growth are of use in supporting infested plants if of material suited to its special nature, but nitrate of soda (so far as reports to myself go) has proved nearly or wholly valueless as an antidote to Eelworm-sickness.

Of special applications for Clover and Oats, whether as preventives, as manure in the preparation of the land, or as dressings to bring a crop over attack, sulphate of potash alone; as a mixture with sulphate of ammonia; or both of these with phosphates, have been found most serviceable.

Sulphate of potash at the rate of 1 cwt. per acre has had a good effect in stopping the disease and bringing a good crop;—also at the rate of about ½ cwt. per acre it has done well.

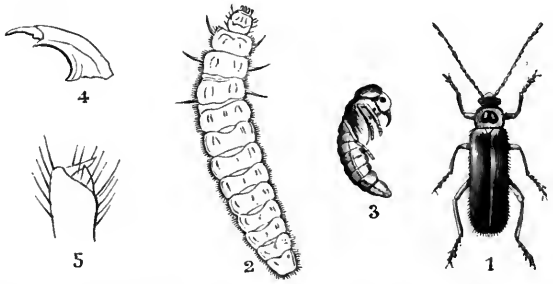
As a manurial application, a mixture of about two parts sulphate of potash, three parts sulphate of ammonia, and four parts of phosphates, brought remarkably healthy plants, with few exceptions.

A recipe found to answer well in case of attack in "Tulip-rooted Oats" or "Stem-sick Clover" is—sulphate of ammonia four parts, sulphate of potash one part, and steamed bones two parts: this at the rate of 1½ cwt. per acre, followed up by a dressing of 2 cwt. per acre of sulphate of ammonia.

The following note of experiment in treatment of Clover-sickness at Rothamsted, which I was kindly permitted to use, showed entirely satisfactory results:—"A mixture of sulphate of potash 3 cwt., and sulphate of ammonia 1 cwt. per acre, was applied on April 3rd." The disease ceased, and the Clover made a very vigorous growth, which was continued markedly in the second crop. Sulphate of iron at the rate of 2 cwt. also answered very well both for stopping the disease and giving good growth; at the rate of 1 cwt. the sulphate of iron was not so serviceable.

A rotation such as will not give immediate succession of a crop liable to Eelworm injury to one which has suffered from infestation (as may be in the case of alternation of Oats and Clover) either at once or before sufficient time has elapsed for clearing the land of the wormlets, *is of great importance.*

BENEFICIAL INSECTS.—**Soft Beetles; Soldier Beetles; Soldiers and Sailors.** *Telephorus rufus*, Linn.; *T. clypeatus*, Ill.; and other species.



1, TELEPHORUS CLYPEATUS, magnified (size given below). T. RUFUS: 2, larva; 4, jaw of larva; 5, apex of antennæ, showing the two processes, much magnified (after G. R. Waterhouse). 3, T. FUSCUS, pupa (after De Geer).

It is somewhat difficult to place the infestation popularly known by the above English names under any appropriate heading, as the very common soft and carnivorous beetles are to be found on various kinds of flowers, and the equally carnivorous larvæ are also not limited in their locality; but some observation as to their *beneficial* habits in ridding us of small vermin is needed, as they are too often credited (so to express it) with causing us much harm. In the present case the heading of Clover is perhaps as appropriate as any, as it will be seen that the larvæ sent me during the past season were from Wheat sown after Clover; and on reference I find one species of *Telephorus* larva has been found so serviceable in destroying the maggots of a Plum Weevil in America, that very possibly we might find on research that our own *Telephorus* maggots also did good work amongst the maggots of our own Clover-leaf Weevils.

The *Telephorus* larvæ are long, somewhat slender, and parallel-sided; the edges of the segments well marked. They are black or very dark in colour, and may have reddish or white spots; the texture is velvety, and the head is exposed, and the abdominal segments rounded.

The beetles are of from about a quarter of an inch to half an inch in length, soft-bodied, long and narrow in shape (see above figure), and with flexible wing-cases, the horns (antennæ) thread-like, and legs long. They fly readily in the sunshine, and are to be found in spring on flowers, especially on those of the Whitethorn and of *Umbelliferæ*—that is, of the very many kinds of flowers growing in a many-stalked head from a central point, in the manner of Carrots and Parsnips.

What may be the reason for their bearing the popular name of "Soldiers" I do not know, unless it may be (quoting from Rye's 'British Beetles,' p. 141) that they are "warriors à outrance" (fighters to the death). They are described by Prof. Westwood as "very voracious, feeding upon other insects, and devouring such of their own species as they can subdue, the females not even sparing their mates." Also De Geer (see reference further on) notes having observed a female beetle in the act of holding a mate wrong side up with her feet while she gnawed an opening into its abdomen with her jaws.

For some years back inquiries have been sent me as to the (supposed) injurious habits of the beetles; but in the past season specimens of the larvæ were sent me on February 1st from near Faversham, with a memorandum that the observer was sending some sort of caterpillar that he had found eating his Wheat, which was sown after Clover. Information was requested as to what the creatures might be, with the further observation: "I have sown lime over the field to try and get rid of them" (F. N.).

As I was not able myself to make sure of the kind of larva sent, I submitted the sample to Mr. O. E. Janson, who replied that the "velvety larva" was undoubtedly a *Telephorus;* and further noted that only three or four species of *Telephorus* larvæ had been identified, and they were almost identical in larval stage, but my specimens agreed very well with the descriptions and figures of *T. rufus* given by the late G. R. Waterhouse in the first volume of the Ent. Soc. Trans.; "*fuscus* and *lividus* have also been described, and are very similar" (O. E. J.).

As the appearance of the larva or grub is so little known, I give Mr. Waterhouse's description at length, with the short but very valuable observation as to locality and date of feeding.

"*Telephorus rufus*, Müll.—*Larva*. Head coriaceous, pitchy black, furnished with two stemmata, one on each side close to the insertion of the antennæ. Body soft, of a dark brown colour, and very thickly covered with soft fine hairs, giving it the appearance of velvet.

"Length 7½ lines.

"*Head* depressed, subquadrate, the basal half covered with a fine pubescence, of the same velvet-like texture as the body; the anterior half smooth. *Antennæ* with the basal joint short; second rather elongate, and containing two small processes partly within the apex. *Maxillæ* soft and fleshy, thickly covered with hairs, especially on the inner side which is bilobed. *Maxillary palpi* four-jointed, basal joint short; second moderate and cylindrical; third short and indistinct; terminal slender and acute. *Mandibles* long and acute, unidentate internally.

"Body elongate, slightly depressed, the joints nearly equal in

width (taken longitudinally of the insect); the three first segments each with two impressed foveæ. Telum soft and unarmed, but with a fleshy protuberance beneath, which is used as a proleg. . . . This carnivorous larva is remarkable for having two processes, which spring from the second joint of the antennæ, instead of a single joint, as is commonly the case in coleopterous larvæ.

"It is found during the winter and spring months at the roots of grass and in decayed wood; it assumes the pupa state about the latter end of April, and the perfect insect makes its appearance in May." *

In De Geer's account of the habits of *Telephorus*, with descriptions of many of the species, given at pp. 57–79 of the 'Memoir' referred to below, † will be found at pp. 68, 69 his personal observations of the carnivorous habits of the *Telephorus* larvæ which he especially watched, both as to destroying each other, and also destroying earthworms placed in captivity with them, so that of the three earthworms under observation one was consumed, and the two others were attacked, and of various of the *Telephorus* larvæ nothing (beyond some remains) was to be found.

The surviving larvæ were found on May 28th to have turned to the pupal stage in the earth in which they were confined, without forming any kind of cocoon. The pupæ were about six lines in length, somewhat arched along the back, and the various parts of the forming insect plainly discernible; and during the month of June the development of the beetles (in this case *Telephorus fuscus*) took place from the chrysalids.

From the observation of Prof. Westwood that he had repeatedly found *Telephorus* larvæ creeping about footpaths, in moss, &c., in the winter and spring months, and also from the remark (p. 31, preceding) of my own correspondent that he found the grubs sent me amongst Wheat, it is presumable that they do us good service in clearing plant vermin both above and below ground, and more observations as to their habits would be useful.

It is mentioned by Dr. J. B. Smith ‡ that the larvæ "are especially effective against such creatures as the larvæ of the Plum *curculio* when they enter the ground to pupate, and a large proportion are thus disposed of annually."

The very common "soft" beetles bear a strong resemblance to

* See Trans. Ent. Soc. Lond., vol. i. p. 31, and Plate III. figs. 3*a* to 3*g*. (Figure of larva, jaw, and extremity of antennæ at p. 30, preceding, are copied from these figures.)

† 'Mémoires pour servir à l'histoire des Insectes.' Tome quatrième. Second Mémoire, p. 57. Figures given at Plate 2 in same volume. Stockholm, MDCCLXXIV.

‡ See 'Economic Entomology,' by J. B. Smith, Sc.D., Entomologist to the New Jersey Agricultural College Experiment Station, p. 191.

each other, and the magnified figure of *T. clypeatus* at p. 30 is a fair guide to their general appearance. This species is more especially distinguishable by the thorax or fore body having a whitish margin, and a glossy black central spot; the legs and antennæ pale.

T. rufus is the same length as the above—that is, from a quarter to a third of an inch—and testaceous red in colour; the thorax spotless; eyes, wings, breast, and foremost segments of the abdomen at the base black.

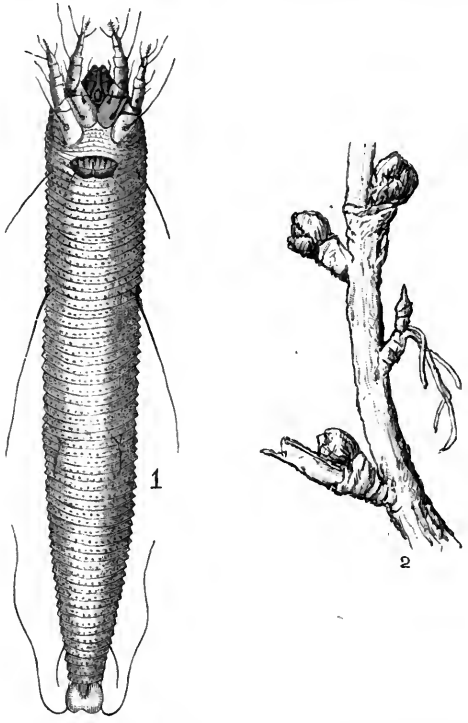
CORN AND GRASS.

In the past season the presence of Hessian Fly (*Cecidomyia destructor*) and that of Corn Sawfly (*Cephus pygmæus*) has not been reported as mischievous, otherwise almost all, if not all, the ordinary corn and grass insect infestations have been present. Daddy Longlegs (*Tipula*) attack was more than customarily reported; Wireworm (*Agriotes*), as matter of course, was troublesome; and the Common Cockchafer (*Melolontha vulgaris*) and the yet more troublesome Garden or Rose Chafer (*Phyllopertha horticola*), of which respectively the grubs are often seriously injurious at the roots of grass and other crops, were also present; and the Antler Moth (*Charæas graminis*), of which the caterpillars are at times devastatingly mischievous to large areas of grass in mountainous districts in the more northerly parts of England and southerly parts of Scotland, made some amount of appearance in Surrey.

Other attacks, whether to the blade, or the ear, the stem, or by distorted growth, as in the case of "Tulip-root" attack, caused by Eelworms, were present to a greater or lesser extent as usual, and are enumerated in the list given in the Preface. No additions of importance have, however, been made to published information of habits, or means of prevention and remedy, and it has seemed unnecessary to enter on these again. The reader is referred for details regarding them to their various names in the General Index to the series of Annual Reports which will shortly be issued.

CURRANT.

Currant Gall Mite. *Phytoptus ribis*, Nalepa.



PHYTOPTUS RIBIS, greatly magnified; natural length of female 0·23 mm. (By permission, after Dr. A. Nalepa.) Black Currant twig with three buds affected by Mite Galls, and one bud unaffected.

Currant Mite Galls have continued to be as prevalent and to cause as much loss to growers as in previous years. The only methods of lessening the evil to some degree which appear to auswer practically is that of breaking off the galled buds and destroying them.

Most careful and continued experiments at the Woburn Experimental Fruit Farm as to effect of chemical dressings, of which I was permitted to give the main points proposed in my Twenty-first Annual Report, pp. 154–158, were carried out, accompanied by microscopic examination at intervals to ascertain whether the Mites in the buds might have been destroyed by the applications without injury occurring to the growth of the buds themselves. This, however, I believe, was not found to be the case, and I only just allude (by permission) to the general result here, as I understand that a detailed report will be given.

At present (besides continuation of other experiments) observation is being made as to presence or non-presence of the *Phytopti* about the base of the stems of the Currants or in the earth round them. In this I am able to co-operate to some small extent, for during somewhat more than eleven years in which I have had the Black Currant bushes in my garden here (at St. Albans) under my observation, I have never found any presence at all of Mite Galls. Therefore it is fair to suppose that if the quite cut-down bushes, with the remains of the stumps and the adhering earth treated in various ways, which have been transferred to my garden from Woburn for special observation, should prove in the coming summer to be infested, that in this case the Gall Mites must have survived the treatment, and been conveyed on the stumps or in the earth.

Should (on the contrary) these cut-down and dressed plants continue free from infestation in the uninfested ground, and similarly cut-down and dressed plants in the neighbourhood of infested bushes at Woburn show the pest, it would point strongly to the Mites straying about, and this being one way of the trouble spreading.

For a long time it was said (and truly) that we did not know the history of the Mite, but, thanks to the observations of Dr. Nalepa, of Vienna, and Mr. Robert Newstead, Curator of the Grosvenor Museum, Chester, this has long ceased to be the case; we know what the life-history of the Mites is on the bushes throughout the *whole of the year*. To what extent they may stray about on, or in, the ground at the roots of the bushes we cannot at present tell, but the regular life-history is as follows.

This *Phytoptus ribis*, which is the cause of so much mischief, is a Mite so small as to be invisible to the naked eye, and differing from the greater part of the families of *Acarina*, or Mites (which are eight-legged, except in their youngest condition, and more or less oval in shape), in being *cylindrical*, somewhat tapering to the tail, and having throughout the whole life *four legs*; the two pairs being placed beneath the body just behind the head or mouth parts (see greatly magnified figure, p. 34). Consequently on the action of these Mites within the forming buds (or close to them) as early as the beginning of June, when the leaf-buds are little more than a line, or the twelfth part of an inch, in length, the swollen growth is formed which we know only too well.

The history is as follows: Starting with the beginning of the year, the Mites may be found in January in the infested buds in perfect condition, and unaffected by even severe frost, beyond possibly making them somewhat sluggish; and in February egg-laying was found to have commenced on the 20th of the month, and eggs to be found in hundreds in company with the adult Mites. By March 6th there were

"thousands of young forms (nymphs), eggs, and adults." By the 19th of April, and also at the date of examination in May, many of the galled buds were found to have opened, and to be dead and dried, and "those buds that were quite dead and dry . . . . were covered by the desiccated bodies of the Mites, and not a living example to be found amongst them."

Where the buds were completely dead and dry, as in the above instance noted on April 19th, it was to be expected that such of the Mites as had not left them should have died, and this leads on to the *observation* of the very important point of the *summer migration and settlement first by, then into, the young buds in their first growth.*

On June 2nd the new buds were found on the first half of the newly formed shoots, still only about a line in length, just protruding behind the leaf-stalk; and "between the base of the leaf-stalk and the buds at the ends of the young shoots," both adult and young Mites were found. No Mites were found at this date (June 2nd) *in* the young buds, and these occurred near the terminal buds only, and at this date only one of the old galled buds was found in a living condition, "and this simply swarmed with adult Mites."

On July 17th, Mites and many eggs were found between the leaf-stalks and the buds; and ten days later, terminal buds "were already *showing signs of being infested.* On examination, these were found to contain adults, nymphs, and eggs, nearly all of which were located in the centre of the buds. This was the first occasion I found the Mites within the newly formed buds" (R. N.).

Later on, that is, on September 13th, the new buds were much swollen, and measured up to as much as a quarter of an inch in length, and contained the pest *within them* in all its stages; but Mr. Newstead observed: "I could not, however, find any of the Mites behind the leaf-stalks as previously, so that I concluded they had taken up their winter quarters for good, and had set to work in earnest to ruin the crop of fruit while yet in the bud."

Thus we have observation, *at the intervals of examination*, of the presence of Mites in the buds from the last days of July, when the *first* infestation was observable in the *embryo* buds, round to June in the next year, when the infested buds and much of their Mite tenants are dead or dying, and the living Mites are migrating and setting up location between the forming buds and the leaf-stalks, as a preliminary to taking possession.

In the words of Dr. A. Nalepa, the especial observer of the *Phytoptidæ*:—"In the latter part of summer and in autumn the Mites leave the galls in multitudes to take possession of their winter quarters—that is, the buds. This emigration also is of frequent occurrence during summer when the previously inhabited buds dry up."

The above notes are abridged from the publications referred to in the foot-note.*

THE GREAT POINT calling for observation is the fact of *migration* at the date *which is shown* by the old galls which have fed their (so to say) "pestiferous" contents during the autumn, winter, and spring dying and drying, and the Mites (no longer being able to gain nourishment, and also in some cases their term of propagation and life being over) consequently also dying in very great numbers; whilst others, presumably amongst the adult Mites, such as were ready for, but not exhausted with, propagation, and also young Mites in incomplete stage, removing themselves by voluntary migration to the embryo buds, and beginning their arrangements for the next year's mischief.

THE ATTENTION OF READERS IS PARTICULARLY REQUESTED TO THE ABOVE CIRCUMSTANCES in regard to the statements somewhat idly made by those who have not taken the trouble to study the information published on the subject, that "we do not know the life-history." How we can utilize it remains to be seen, and as facts stand they show that what is *especially needed* is syringing that will lodge dressings, pernicious to the *Acari*, or Mites, in the axils of the leaves at the very time of all others when the ripening or ripened state of the fruit makes it most desirable that the bushes should *not* be meddled with in the way of being put under treatment. It also shows that the transference of the Mites is peculiarly liable to be assisted by their adherence to the clothes of the workers brushing about amongst the bushes where these are grown in areas of fields of many acres unmixed with partition bands of other bush or ground fruit or crop not liable to Mite infestation.

It is open to proof that breaking off the galled buds and destroying them *must* lessen amount of coming infestation; amounts varying from 1½ to 16 quarts picked off per acre speak for themselves, and *if much* benefit accrued, the cost varying from 3s. 6d. to 10s. 10d. per acre would not be of very great importance. But we want something better; the researches now going on may bring to light some unexpected method of lessening the trouble; but we have before us the absolute certainty that the method of growing Black Currants in close rows and large areas, from large quarters up to fields or acres in

* 'Die Naturgeschichte der Gallmilben,' von Prof. Dr. Alfred Nalepa, pp. 15, 18. (Erganzter Sonderabdruck aus dem ix Jahrsberichte des K.K. Staats-Gymnasium in Wien iv Bezirk.)

"Recent Investigations of the Currant Bud Mite (*Phytoptus ribis*)," by R. Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, Lecturer on Economic Entomology for the Cheshire County Council, pp. 5–7. Reprinted from 'The British Naturalist' for June, 1894. Price 3d.

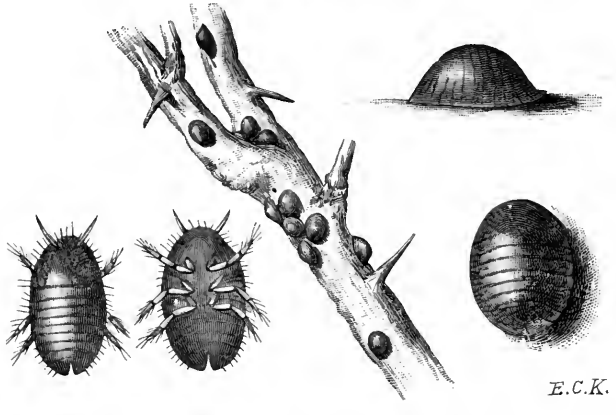
extent, and this on the same ground year after year, gives every accommodation and facility for the increase of the Mite pest that possibly can be.

There is more shelter, more breeding-ground, the spread of the infestation is not nearly so much under observation as where rows or plots of rows are accessible, and likewise during the weeks in the summer when the Mites are migrating there is great facility for their transportation in the plumage of birds and on the clothes of workers who move amongst the infested branches.

Where strips of other fruit bushes or crops are grown amongst the Black Currants it gives safety in many ways, and we know that the plan has been found to lessen the amount of mischief. My own view certainly is that where Black Currants are constantly grown in close rows of large breaks, or quarters, or by fields of acres, that it must be done at a deduction of percentage of labour for picking galls, besides losses on the crop, and great risk of extensive failure.

Currant (Gooseberry and Raspberry) Scale.

Lecanium ribis, Fitch.



Lecanium ribis.—Currant Scale, female, showing side and upper surface; larval Scales, with legs still visible: all magnified. Infested Gooseberry twig.

The Scale insect figured above, which from this autumn's observations may be now known as the Raspberry as well as the Currant and Gooseberry Scale, appears to be gradually spreading. For some years previous to 1893 observations were sent me of a brown Scale found to infest Gooseberry bushes to an injurious amount, and in that year the species was identified for me by Mr. J. W. Douglas, F.E.S., as being *Lecanium ribis*, Fitch. He mentioned them to me as being

found on the Red and on the White Currant, but that (up to that date) he had not personally seen them or heard of them as infesting Black Currant.

In that year, however (1893), I heard of them from Mr. Wm. F. Gibbon, of Seaford Grange, Pershore, as being very destructive on Black as well as on Red Currants; and on careful examination of Black Currant bushes in my own garden, as well as in an adjacent garden, at St. Albans, I found it present on the boughs, although not to any great amount. On the Red and White Currant bushes it was very noticeably present.

Since that time little, if anything, has been reported about it until in the month of November in the past season I received from Mr. Walter J. Lavender, of Petersfield, a number of pieces of Raspberry cane showing very decided presence of infestation of fine specimens of female Scales, which he considered to be of *Lecanium ribis*. For the sake of obtaining certain identification, I submitted the specimens (on the canes) to Mr. Robert Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, who was good enough to examine them, and informed me that the specimens were *Lecanium ribis*, Fitch, ♀ (= *L. coryli*, Linn.), and added:—"The specimens are unusually large, and in this respect approach *L. rosarum*. They are the first examples I have seen on Raspberry, and for that reason are interesting. The insect is undoubtedly a general feeder, for I have also received it on one of the Conifers."—(R. N.)

The female of this species of Scale is shown in natural size on an infested Gooseberry twig at p. 38; likewise in side and upper view, much magnified; and (likewise magnified) in larval state, whilst still in active condition, and possessed of six legs and a pair of horns.

On requesting any further information from Mr. Lavender which he might be disposed to give me regarding the attack in its new connection with Raspberry, he was good enough to write me on December 1st as follows:—

"It was certainly as early as February, 1897, that I first observed *L. ribis* upon Raspberry canes in this garden. The female Scales were then in all stages of development, varying in colour from almost light sienna tint to dark rich lustrous red-brown, so placed upon the stems as to the casual observer to appear excrescences upon the bark.

"Upon applying pressure with the thumb and forefinger, the lighter-coloured Scales exuded a perceptible moisture, and, removing the darker and harder Scales, they were found filled with the yellowish powder-like eggs described by you ('Handbook,' p. 111). . . . I failed to find the larva. I have since found the developed Scales at all seasons of the year upon the last year's growth of canes,—the

fruiting canes of the year. I have not hitherto observed developed Scales upon canes of the year's growth.

"Yesterday and to-day (December 1st), since receiving the letter you wrote me, I have searched the canes of this year's growth, and have found what I think to be the larvæ before they have lost the power of locomotion.

"I send you as a specimen the whole cane cut off at the ground (severed into lengths for convenience of posting). I counted a dozen larvæ, which apparently are turning into the fixed stage, so closely placed together upon the cane as to cause the outer edges of the Scales to touch. When I first saw them there were many more, so disposed upon the young pale green tender bark as to give the appearance of a brown streak some five-eighths of an inch or more in length, and perhaps three-sixteenths of an inch at its widest, tapering away at each end to a few detached larvæ. Others were irregularly scattered about. The colour, a true chestnut, somewhat dark but bright ('Handbook,' p. 111); but they were very active, and gave me no opportunity of accurate measurement. . . . I have disturbed the bark as little as possible, the tear at the place where the larvæ were found being caused by my finger-nail in searching. Having found some, I did not look further, but send the whole cane to you.

"I suppose the fully-developed Scales having been found early in 1897 pointed to the infestation occurring at least in the preceding year? In my letter to you of the 7th or 8th inst., I attributed my not having found the Scale before 1897 to lack of observation."

In Mr. Lavender's previous letter he had mentioned that the Scale was "too plentiful upon the Red and White Currant bushes," and also present, though to a much less extent, upon the Gooseberries; and in his letter, quoted above, of December 1st he further observed relatively to this point:—

"With regard to the Currant and Gooseberries, the Scale is chiefly upon the under side of the branches, as stated by you ('Handbook,' p. 112),—upon the Gooseberries so much so that an ordinary observer, standing and looking down on to a well-grown, pruned, and open bush, would think it clean; but, on raising the branches, or, better, placing oneself in such a posture as to be able to see upwards through the branches, the infestation is seen in rows and small clusters, single file rows predominating.

"Yesterday, and for the first time, I found the Scale upon some *Black* Currant bushes. I am almost sure my Black Currant bushes have not before been infested. The Scales are perfect female ones, but not so fine as those sent to you upon the Raspberry canes."—(W. J. L.)

On examining the pieces of Raspberry cane referred to by Mr.

Lavender in his letter of December 1st, I found (on the 5th) Scales still in larval state. Some were scattered singly on the soft part of the bark; and in one instance there were a good many, perhaps seven or more, near together. These were of a brownish colour, and on placing several of them in glycerine, one showed itself to be quite in live condition by the active movement of its legs.

The female Scales of this species are hemispherical in shape, of some shade of brownish yellow, or nut, or rich brown colour, and sometimes slightly curved outwards at the lowest edge, and the margin finely wrinkled transversely. The size variable,—in the case of the Currant Scales described by Dr. Asa Fitch, of Albany, U.S.A., about 0·30 (that is, about three-tenths of an inch) in diameter. In the specimens which I examined, taken from Gooseberry bushes in my own garden, the size ranged from an eighth of an inch to rather more; the width about equal to the length; the height about one-twelfth of an inch or rather more in the middle. The general surface was so irregularly varied according to age and condition as to make it impossible to give a precise description.

The maggots, or larvæ, were so small as to be almost invisible to the naked eye, narrowly oval in shape, with six legs, and a pair of horns (see much magnified figure, p. 38). The colour varied much, from some shade of ochrey to puce or reddish, the body was somewhat raised along the middle so as to form a slight keel, and the abdomen of the larvæ as well as the female Scales showed a more or less noticeable caudal cleft.

In regard to the life habits, it appears to me that we may find the Raspberry less liable to very injurious presence of attack consequently on the upright growth of the canes throwing the infestation much more open to weather influences than in the case of Scale presence on Gooseberry and Currant, where much more shelter is afforded by the branches.

On March 10th (1893), when I found both females and larvæ of this *L. ribis* very prevalent on Gooseberry bushes in my garden at St. Albans, the female Scales were numerous on the old wood, *and mainly beneath the branches, where they were sheltered from weather*, and where the bark was often split or peeled away so as to expose the under surface; but (*up* to that date) the infestation was not noticeable on shoots of the preceding year's growth.

In the notes of habits of the Scale sent me by Mr. W. F. Gibbon, of Seaford Grange, Pershore, as the result of the observations of one season verified by those of the next, he remarked that the young Scale emerged from the egg early in the spring; he found them hatched out early in February, and walking with freedom on their six legs. At first they were almost transparent, but they soon became of a

chestnut colour, and assumed the shape of a small wood-louse, and then secured a position by inserting their beak into the bark, and speedily increasing in size.

"When about three-fourths grown their covering appeared very shiny and sticky, and, later on, dry and harsh. In May I found the Scale matured and eggs deposited, and on the 18th of June the eggs hatched, and the young *are now*" [July 15th, E. A. O.] "on the move, and it is at this stage of their existence to apply washes for their destruction. The young now wandering about will soon affix themselves to the bark, assume a hard covering, and mature; by autumn deposit eggs, which will hatch next spring. There are consequently two generations in a year."—(W. F. G.)

Mr. Gibbon mentioned this species of Scale being very destructive.

In my own observations I found on June 6th female Scales, in most instances full of eggs, on some Gooseberry bushes which had not been much attended to, and by the end of July I found multitudes of young Scales had been hatching, and were noticeable on a bough which had been brought under cover, although on Gooseberry branches exposed to weather, insect attack, &c., out of doors, there was little larval presence to be seen, although there were plentiful remains of egg pellicle.

It should perhaps be just alluded to for those not acquainted with the life-history of Scale insects, that the brown shiny skin is not the real female, but the coat beneath which she has changed from the early stage to what, to the naked eye, appears a mere lobed, fleshy, greyish lump, containing or surrounded by, according to condition, innumerable quantities of eggs, so minute as to fall, on disturbance, like a shower of white dust.

Prevention and Remedies. — In regard to checking attack on Raspberry canes (the locality of infestation which has not previously been brought forward) one desirable method would be to cut down the bearing canes of the year as soon as is reasonably possible after the fruit has been cleared. Thus a great amount of the female Scales would be got rid of from the beds, and might be easily destroyed by burning those canes *which have fruited*. We have not observations as yet of the *female* Scales being found on the canes of the current year's growth (those that would furnish the bearing shoots of the following season), only of the larvæ, the still active Scales in very young state, being found on these, and conjecturally the specimens found will have strayed from what may be described as the family headquarters on the bearing wood.

So far as I am acquainted with the habits of this species, it appears to me to be unusual that the larvæ should be observable in active life

at the date at which they have been now observed, namely, the beginning of December. This date appears to be too late (in regular course) for the summer brood, and too early for the winter or early spring brood, which hatches (see p. 41) in February. Possibly the mild season may have made a difference, but unless the species when on Raspberry customarily occurs thus in larval state at the end of November or beginning of December, the practice of clearing the *fruited* canes with their infestation might be expected to keep it well down.

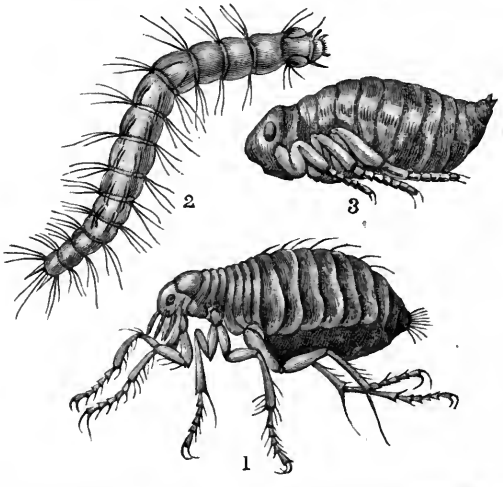
For prevention of attack in the ordinary cases of infestation on Currant and Gooseberry, the date of winter pruning is very important. It is desirable that this should be done, and the Scale-infested boughs cleared from the bushes, and also from the ground where they fall in pruning, *and burnt* before the time when the larval Scales will be hatching and dispersing themselves about bushes. *It should be done quite by the commencement of February.* Also it is desirable, after the prunings have been gathered up, to *stir the surface* of the soil under the bushes, and to throw a little quick-lime, or any preventive mixture preferred, on the soil just round the stems to prevent the little Scales making their way back to the branches.

Currants trained on walls require attention, and perhaps a rod occasionally taken out, down to the root. In my own garden I have found the Scales in patches at intervals on a length of several feet of White Currant.

Looking at the manner in which the Scales shelter under ragged bark, and also (especially in the case of Gooseberry bushes) on the under side of the branches where these are thick enough to protect them from weather influences or other enemies, it is obvious that attention should be carefully directed to these points, both by pruning off old rough boughs where this treatment is allowable, and by spraying, and also by running soap wash on and down the infested boughs, so as to lodge in the rough bark and kill the tenants. Probably any of the common soft-soap washes, especially those that are mixed with sulphur or mineral oil, would be of use; and in communication with one of my correspondents he mentioned that he had found "Chiswick Compound" very effective in destroying Scale on his infested Gooseberry bushes. This mixture is procurable from the Chiswick Soap Company, Chiswick, Middlesex, and probably it would be as serviceable an application as could easily be found, as it is a mixture of soft-soap and sulphur, which act well against these kinds of bark infestations, and it has the advantage of the sulphur becoming soluble (so as to be completely mixed with the wash) in from sixteen to twenty-four hours after the requisite amount of *hot* water to dilute the mixture to a safe strength has been added.

FLEAS.

House Flea. *Pulex irritans*, Linn.
Cat and **Dog Flea.** *Pulex serraticeps*, Gerv.



PULEX IRRITANS, larva, and pupa—all much magnified.*

On September 22nd, in the past season, my attention was very urgently directed to an outbreak of what on examination proved to be male and female Fleas, but in such numbers and so pervading the district reported from, that our common house and domestic pests had not been recognised. On mentioning the occurrence to another correspondent, information was sent me of the appearance of similar annoyance, although not on such a great scale, in other localities, these infestations presumably being all due to the long drought, which left the haunts of Flea *maggots* round farm or homestead in the dry condition most favourable for their feeding and progress, instead of this being checked, as in common seasons, by ordinary rainfall and plentiful supply of water being available to wash their lurking-places, respectively out of doors or under shelter, into a state wholly injurious to them.

Most of us are well acquainted with the common Fleas as minute, flattish, brown, shiny insects, blood-sucking in their habits, and with the power of taking tremendous leaps. But very few in comparison know that the Flea in its early condition is as different from the perfect insect as a fly maggot is from a fly. It is a slender, whitish,

* From figure 76, p. 141, of 'Insects Affecting Domestic Animals.' U.S.A. Department of Agriculture, Washington. 1896.

footless larva (see figure, p. 44), with a pair of horns, and a pair of biting jaws, and is to be found in dry places, as (in houses) on rugs, or cloths, or carpets, or any similar dry localities, where the eggs from Flea-infested animals lying on them fall, and where the maggots feed on the fragments of the various kinds of *dry* material to be found. There they change to the chrysalis state in a cocoon, from which the Flea soon emerges, and (necessarily) where the conditions have been peculiarly favourable for the growth and development of the larva, there will be peculiarly great presence of Fleas, and they will spread intentionally or accidentally so as to be really serious inflictions in the district.

On September 22nd the following account of such a visitation was sent me:—

"One of the villages I have visited, . . . *viz.* the village of Haslington, I found was literally swarming with the enclosed insects; cottages, fields, especially a large farmhouse (the inmates, it may be mentioned, being scrupulously clean); these insects were found in thousands in the house, bedrooms, personal clothing, as well as outside, really in small colonies; better class as well as the poorer being alike troubled."

Inquiries accompanied as to the nature of the insect, reason of its presence, and means of getting rid of it, with the further remark:—

"All ordinary means have been used in the farmhouse which I allude to with no success. This plague (for so it appears to be) commenced about five weeks ago all at once, and shows no signs of diminishing. I should be glad to know your opinion on the subject, with the remedy, in order to make this known as soon as possible." *

On November 30th, Mr. P. Hedworth Foulkes, of the College, Reading, writing to me on the subject of the above Flea infestations, observed:—

"I heard just before coming back to Reading in September of a similar plague in North Wales. Two or three houses belonging to people in good position, as well as houses belonging to artisans, were quite suddenly found to be swarming with the pest. There seemed to be no reason to account for their sudden appearance. One house was nearly two miles from the town, and the nearest dwelling three-quarters of a mile away. In another case three houses in a block were suddenly found to be practically swarming."—(P. H. F.)

With regard to similar infestation (though not on such widespread scale) I can speak from personal remembrance of Flea presence in the buildings of a farmyard that I was acquainted with for many years of my life, where a large covered poultry house and other covered

* In this case I have not given my contributor's name, as I am not sure that he wished me to do so.

buildings, well adapted for *dry* shelter and nurture of Flea grubs, ranged continuously along one side of the yard. The Fleas which swarmed occasionally about the place were little less than a visitation.

A great plague of Fleas is sometimes accommodated in such places as the hassocks of a large church or cathedral, where there are free sittings, or in the matting of a library, where circumstances are more in favour of their taking possession than being removed. In the case of the hassocks, I have known a periodical cleaning to disclose such armies of the parent Fleas making their way from the disturbance of their hassock head-quarters being beaten in the churchyard, that there can be no reason for doubting that much of the future Flea supply would have been found housed there if investigation was made.

In the case of infested matting, an instance was given me of presence of the plague in an old school or college library. In this case it was only on raising the matting that the insects were discovered. They appear to have been the common Flea, and the workmen were the people who suffered. As the room was being cleared out to be used for another purpose, the matting was destroyed, having been down for about five or six years.

Besides the numbers of published instances on record of Flea grubs and eggs being found on rugs or dry places where infested household animals habitually lay (even to half a teaspoonful of Flea eggs being collected from a lady's dress who allowed a much-infested "pet" to make her lap into its bed), I have known much commotion caused by a quantity of "something" being found on the top of a small ottoman where a house spaniel spent much of his time, and which proved to be Fleas in egg or grub state, but, as so very often is the case, not known to be such.

The following account of the group of insects commonly known as Fleas, in this case scientifically classed as *Siphonaptera*, extracted from the U.S.A. publication by Prof. Herbert Osborn noted below,* is given as a reliable condensed account of the characteristics of the group and its life-history brought up to date:—

"The insects of this group are characterized by the entire absence of wings, by having the bodies compressed, the legs long and stout, the coxæ† being remarkably developed, giving them great leaping power. The mouth parts are well developed, and adapted for suction, all the species in the adult stage feeding upon the blood of mammals

* 'Insects Affecting Domestic Animals' (species of importance in North America), p. 141, by Herbert Osborn, Professor of Zoology and Entomology, Iowa Agricultural College, U.S.A. Department of Agriculture, Division of Entomology, Washington. 1896.

† *Coxa*, the hip; the chief division of the legs of insects, between the *femur*, or thigh, and the *thorax*, or fore body.

or birds. The antennæ are small, usually sunken in a pit or groove in the side of the head, and of peculiar form, the third or terminal segment being annulated, or, in some cases, even divided into leaf-like plates. The eyes are simple when present, but in many cases they are reduced to mere rudiments, or even completely wanting. The tarsi are five-jointed.

"They undergo a complete metamorphosis,* the early stages being passed in places adjacent to the resorts of the host. The eggs, while sometimes laid upon the hairs of the host animal, are loosely attached, and must ordinarily be scattered in places where the host-form sleep or nest. The larvæ, so far as known, live in dust or litter in similar locations. They are slender, worm-like, footless objects, with a sparse covering of hairs. The pupæ form in similar locations, enclosing themselves in cocoons. Westwood says:—'When full-grown, which occurs in summer in about twelve days, the larvæ enclose themselves in a small cocoon of silk, often covered with dust, and attached to surrounding substances. Rösel, however, observed that some of the larvæ underwent their transformations without forming any cocoon.'" —(H. O., in work quoted.)

The author further observes that, though Fleas are parasitic in the adult stages, they are not strictly confined to the host animal, but wander from it at times, and may even be found on different species of animals from those which are evidently their regular hosts.

The following further points of interest in the Flea life-history, taken generally, are extracted from the very useful book mentioned below †:—

"The little Fleas are simply the males, which are considerably smaller than the females. . . The males also differ in shape, and have the hinder end of the body somewhat turned up." In Mr. Butler's figures of a male and female Flea, plate v. of his work referred to below, this difference in size and shape is very well shown. The female Flea in the figure at p. 44, at heading of this paper, shows the oval form of the extremity of the abdomen well, corresponding in shape with the photographed figure by Mr. Butler; in the male, as also shown in the figures by Mr. Butler and Dr. Taschenberg, the lower part of the abdomen and appendages is turned up so that the extremity forms a kind of terminal mass on a level with, or rather higher than that of the line of the back of the abdomen, and divided from it by a deep notch. The figure at p. 48 of the Cat and Dog Flea gives some idea of this form in much magnified detail, and the

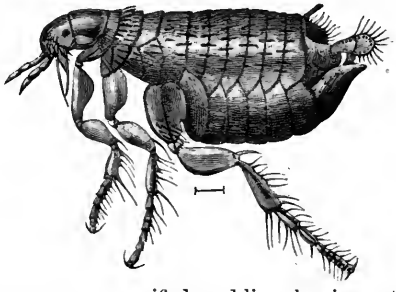
* That is, they are *not* (like Grasshoppers and some other insects) almost similar in general shape throughout all their stages.

† 'Our Household Insects,' chap. xiv., by Edw. A. Butler, B.A., B.Sc. London: Longmans, Green & Co.

difference of shape was very observable in the specimens sent me last autumn. See p. 44.

Of the habits of the House Flea (*P. irritans*), quoting from various observers, it appears that the larvæ, or maggots, attain full growth in about eleven or twelve days, and occupy about twelve more days in maturing in pupal state, from which the perfect Flea develops, at first as whitish in colour, but soon assumes its brown colour. In winter, the time of development, even in a warmed room, is somewhat longer.

The Cat and Dog Flea (*P. serraticeps*, Gerv.) may be distinguished from the House Flea (*P. irritans*) by the presence of "combs of spines



PULEX SERRATICEPS, magnified, and line showing natural size.

on the border of the head and pronotum "*; a comparison of the edge of the head and of the segments behind the head in the figures of Fleas given at p. 44 and above will show this difference clearly. This kind is said to be generally distributed, "practically over the entire world"; but as in general appearance (to mere examination by the naked eye), and also in habits, it much resembles the House Flea, it seems unnecessary here to go into minutiæ.

There are various other kinds, as *Pulex avium*, Tasch., infesting many birds, including domestic poultry; *P. fasciatus*, Bosc. d'Antic, or Rat and Mouse Flea; *P. sciurorum*, Bouché, infesting squirrels (in Europe); *P. goniocephalus*, Tasch., and other species, which are not now (though they formerly for the most part were) included in the single family of *Pulicidæ*, which has now been more specially restricted to the forms "in which the female abdomen does not become swollen, and the labial palpi are from three- to five-jointed." †

In the above notes I have tried, to the best of my power, to give some main points of information brought up to date, and which may, I trust, be found reliable. But those who search the accounts generally referred to will appreciate the great difficulty of reconciling many of the statements, not only as to position of the family and its

* *Pronotum*, the upper part of the prothorax—that is, the foremost division of the fore body.

† See 'Insects Affecting Domestic Animals,' previously referred to, p. 142.

recent division, but also in respect of nomenclature of species, habits, and means of prevention.

Prevention and Remedies.—The following observation on "destruction of Fleas" is taken from the work mentioned below* :—

"To destroy those of Dogs, insecticide powders which have for their basis the flowers of pyrethrum, stavesacre, or wormwood, are sprinkled over the animal, so as to fall between the hairs; or the skin may be rubbed with common or laurel oil, with which a little powdered tobacco" [care should be taken as to amount of tobacco, or much harm may be done to the animals, E. A. O.] "has been mixed, and a soap-bath given twelve hours afterwards. Some people are content to use sulphurated, benzinated, or creolined water, or powdered parsley or wormwood.

"Cleanliness, baths, washing with potash, carbolic, or cresylicated soaps prevent the multiplication of Fleas. Kennels or other places invaded by these creatures should be treated with boiling water or limewash.

"Pine shavings have been recommended as bedding for Dogs, with a view to keep away Fleas. It has also been recommended to have the floors of kennels made of the staves of old tar barrels, laid edgeways between the stones. The persistent odour of the tar does not hurt the Dogs, and it drives away the Fleas. The same result is arrived at in sprinkling on the floor creoline powder, or creolinated water, five or ten per cent.

"For poultry, the same measures may be adopted, or those prescribed for lice."—(L. G. N.; trans. G. F.)

Remedial dressings, however—as, for instance, of pyrethrum, or even sprayings with benzine—do not seem always very certain in their action; and, failing these, the simple and effective method advised by Dr. L. O. Howard (Entomologist of Board of Agriculture, U.S.A.) is to *take up all floor coverings and wash the floor with hot soapsuds.* This treatment can easily be carried out in the matter of application of a good supply of hot soapsuds to many cases besides house floors; dog-kennels, hens' laying-boxes, the floors of hen-houses, and outhouses of all kinds may thus be cleared. Good application of moisture, and also taking care that fowl-runs are where the ground is open to rainfall, have been found to answer well.

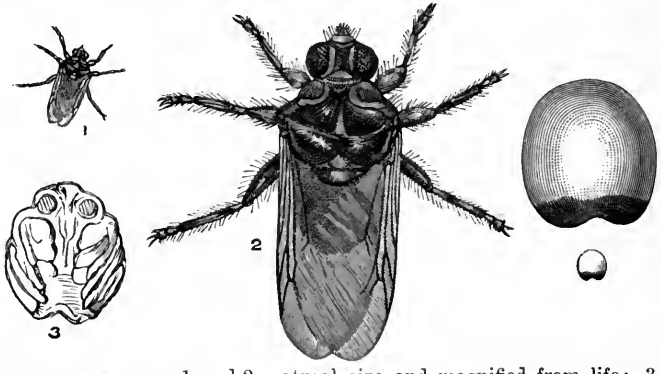
Put shortly, the fact of the eggs and grubs being found in situations where they are not liable to be much disturbed, as in dust in chinks in floors, in, or on, or under carpets, matting, door mats, cloths, &c., is the point to work on; and besides all applications in the way of

* 'Parasites and Parasitic Diseases of Domesticated Animals,' p. 61, by L. G. Neumann; translated by G. Fleming, C.B., &c.

dressings (and very especially of hot soap and water), a thorough use of the broom, and good shakings of all things which serve as resting-places for domestic animals, and throwing all gathered-up sweepings into the fire, will go far to keep the dwelling-house free of these disturbing pests.

FOREST FLIES.

Forest Fly; Spider Fly; Forester. *Hippobosca equina*, Linn.



HIPPOBOSCA EQUINA: 1 and 2, natural size and magnified from life; 3, pupa removed from egg-like puparium (after Réaumur). Puparium, natural size and magnified, before complete colouration.

The Forest Fly is referred to again this year relatively to observations having been contributed of its presence, to an extent to cause serious inconvenience, in a district of Glamorganshire and the adjacent part of Brecknockshire, thus adding a new locality to those previously known to be infested.

Up to the year 1895, when the circumstance of the autumn military manœvres having been arranged to take place in the New Forest in Hampshire drew considerable attention to annoyances which might occur from this exceptionally troublesome horse pest, this fly was considered, except (I believe) some report of its presence in Dorsetshire, to be wholly confined in this country to the New Forest or its vicinity.

So far back as the year 1781 this species was recorded as being found in great numbers in the New Forest, and as being a great pest to horses and cattle; and the "New Forest Fly" has been one of its special names. Specimens from the New Forest, and likewise from Dorsetshire, are in the entomological collections in the British Museum of Natural History, South Kensington; and in 1895 I received specimens from the valley between Beddgelert and Portmadoc in North

Wales. Since then no definite record has been sent of infestation in other districts until in the past summer I received a plentiful supply of specimens from Dr. D. Thomas, Medical Officer of Health of the Pontardawe Rural District Council in Glamorganshire, with information of the flies being a troublesome infestation in a district of which various places were named lying some miles in a westerly and northerly direction beyond Neath.

The first communication was sent me on August 17th by Dr. D. Thomas, from Tyr-waun, Ystalyfera, Glamorganshire, as follows:—

"I take the liberty of asking your opinion on the enclosed specimens of what are known in this district as 'Forest Flies.' They are a perfect terror to horses,—some animals becoming quite beyond control. Fortunately, according to my experience, they are not very frequently met with. I have generally found them in the parish of Ystradgynlais, in Breconshire, among hillside farms, where there is plenty of scrubby timber."—(D. T.)

The specimens sent proved beyond doubt to be *Hippobosca equina*, Linn., and on mentioning to Dr. Thomas that (the matter being of much interest) I should be very glad of a few more, he wrote me, on August 20th, that the next time he was in the locality he would do all he could to procure additional specimens; also he remarked: "I only wish I could extirpate the whole tribe, for a more terrible nuisance to some horses I have never known."

About three weeks later (on September 9th), Dr. Thomas forwarded me six or seven more specimens, which, on examination, all proved to be of *H. equina*, with the observation: "I am able to send you to-day a few more 'Forest Flies,' and being alive I have put them in a match-box. These were caught on a hillside farm near Crynant Village, about four miles from Neath, Glamorganshire. It is getting a little late in the season, but next year, if you should require any more, I dare say you can have any quantity of them."

The specimens sent me I shared with Mr. O. E. Janson, F.E.S., as I was desirous that examples of presence of *H. equina* in this previously unrecorded locality should be in the collections of a well-known entomologist, as well as in my own; and subsequently Mr. Ernest E. Austen, of the Zoological Department of the British Museum of Natural History, South Kensington, wrote me that, through the courtesy of Dr. D. Thomas, he also had received a supply of specimens for the collections in the British Museum, so that the presence of this truly undesirable horse and cattle pest, *Hippobosca equina*, Linn., in the *south* of South Wales is now thoroughly recorded.

In a geographical point of view it may be worth remark that all the localities of Forest Fly (that is, of *H. equina*) that we are at present acquainted with in this country are not far from the sea. The

New Forest occupies much of the south-west portion of Hampshire. I am not aware of the precise locality in Dorsetshire from which the specimens in the British Museum were procured, but the whole of Dorsetshire lies along or near the English Channel. Glamorganshire lies the most to the south of any of our Welsh counties, and has a long sea frontage; and the localities of the Forest Fly mentioned by Dr. Thomas, namely, Ystalyfera, Crynant, and Ystradgynlais, lie not far from Neath (their position is found without difficulty in the map showing railway stations in Bradshaw's 'Railway Guide'), and Neath is only four miles from the mouth of the river of the same name.

In the case of the North Welsh observations, the neighbourhood in which the Forest Flies were found was the wide valley running from Beddgelert, at the foot of Snowdon, to Portmadoc, a small *seaport* town in Carnarvonshire (in the parish of Ynyscynhaiarn), eight miles distant. Here ponies are kept on the mountains on both sides of the valley in the summer, and a herd of ponies on the lowland both summer and winter, and there is much horse traffic along the road which runs beneath the Snowdon mountain. The Forest Flies were noted as being only seen in the district from the beginning of June to the middle of September, and the specimens sent me were captured on one of the horses of a coach plying between Portmadoc and Beddgelert, and forwarded on June 26th. The specimens and observations were sent by Mr. W. Morris Williams, of Pwlheli, in reply to inquiries sent by the editor of the 'Veterinary Record' to all the members of the Royal College of Veterinary Surgeons in Carnarvonshire as to localities in which "Forest Fly" was to be found.

The Forest Fly, when at rest with the wings laid flat on the back, as figured life size and magnified at p. 50, is three-eighths of an inch in length from head to the extremity of the wings; about a quarter of an inch in length from head to tip of tail. The shape is flattish, and the skin so hard and leathery that it is difficult to crush.

The head is tawny yellow, with a dark stripe down the middle of the face; the compound eyes dark and very large, occupying the whole sides of the head; ocelli, or simple eyes, *wanting*. The *thorax*, or body between the wings, has on each shoulder a large patch or irregular ring of tawny yellow, with more or less of the brown ground colour in the centre, some small pale markings along the middle of the hinder part of the thorax, and *a pale spot in the centre of the scutellum* (that is, of the small portion of the upper part of the thorax just preceding the abdomen). The abdomen is brown, grey below, and, like most of the fly, more or less beset with bristly hairs.

Wings two, strong and membranous, slightly opaque and brownish in colour, and furnished with several strong dark veins placed along the front portion, as exactly figured from life at p. 50.

Legs rather long (when extended flatly, they appear very long), of great strength, and tawny yellow in colour, variously ringed, or clouded, or otherwise varied, with brown or black.

Each foot (or *tarsus*) is terminated by a pair of claws, each of the pair being formed of one large, very strong, much curved, black claw, at the outside of which is placed another much shorter and thicker, forming a kind of thumb-like appendage to the main claw. See figure below. On placing the curved claw in a good light, it can be seen

Foot of *Hippobosca equina*, showing double claws, central process, and long prickly bristle; also portion of side of claw of *H. maculata* (also magnified), showing parallel grooves and saw-edge.

(with the help of magnifying powers) that the lower parts of the sides are furrowed by minute grooves placed parallel to each other, and that the lowest part of the claw has, running beneath it, a regularly serrated, or scalloped, edge, each groove running down to a notch in the saw-like edge. This structure I have also observed in the Indian Forest Fly, *Hippobosca maculata*; see figure accompanying of *portion* of a curved claw very much magnified. Consequently on this peculiar structure, when the fly presses the sides of the curved claws together, they form a kind of flat-sided forceps, perfectly adapted for holding fine objects like hairs, amongst which the presence of the infestation causes exceeding discomfort, or with horses unaccustomed to it quite uncontrollable terror.

Beneath the foot and between the cushions, or pulvilli (see figures above, greatly magnified), is a long stout hair, or rather bristle, extending fully to the length of the curved claws, and bearded with side hairs. The appearance of this appendage varied much according to the circumstances under which it was observed; when seen in natural condition, being well described as a "somewhat plume-like body," but when examined in Canada balsam, instead of the whole length of the

many hairs placed along the fine bristle being observable, only their lower portions were noticeable, the bristle thus having the appearance of being beset by fine spikes. The terminal extremity was not pointed, but ended in about five spines, or moderately sharp spine-like tubercles.

In the course of my observations on the method of movement of Forest Flies and their power of adhesion to upright surfaces, such as the sides of a cardboard box, I found that (when observed by hand-magnifiers of two-inch power) they did not appear to make any use at all of their strong curved claws to help them up the ascent. The claws were thrown up and somewhat back, so as to be clear from any attachment at all, and the fly progressed upwards to all appearance holding by the thick basal portion of the claws only. On investigation I found (at this spot) an appendage, invisible without high magnifying power, which does not appear to have been previously observed, and which, when displayed, proved to be a thin flat membrane, down the centre of which ran a vein, or tube, curving from each side of which were a series of channels, or ridges, running to the edge of the membrane, about twenty in number on each side. This formed a thin flat plume-like flap, at the base of which was a bulb-like formation, thickly covered with hairs.* The general appearance of this membrane bears (at first glance under a high magnifying power) a great resemblance to the flexible lobes known as *labellæ*, which form the terminal portion of the proboscis of the Blue-bottle Fly.† In these labellæ the side tubes (which it is noted by Mr. Butler are called *pseudo-tracheæ* on account of their superficial resemblance to tracheal tubes) differ somewhat in disposition from those in the apparatus in the Forest Fly's foot, as in this case the series on each side starts from the central vein or tube,—in the proboscis of the fly each side series starts from a separate longitudinal tube or vein; but beyond the external appearance, which is given in my two plates referred to in the note, I am not aware of the structure of this part of the foot apparatus of *H. equina* having been entered on.

The *Hippoboscidæ*, to which family the Forest Fly belongs, are distinguishable by not existing *actively*, except in imago state—that is, perfect or fly state. The egg is hatched, and the maggot, or larva, feeds and is nourished up to maturity in the abdomen of the female fly, and when fully developed is deposited, and the change to pupal condition (in all ordinary external characteristics) takes place so

* In my Nineteenth Annual Report two plates are given, in which the foot of *H. equina*, with the claws and the various appendages, will be found magnified; one of these plates is repeated now as frontispiece.

† See figures, much magnified, given in plate ii. of 'Our Household Insects,' by Edw. A. Butler, B.A., B.Sc.

immediately that the name of *Pupipara*, or "pupa-bearing," has been bestowed on this division of the Diptera. This fully-developed larva (or puparium), which is very often mistaken for the egg of the fly, is white when deposited,* and, in the case of *H. equina*, so rapidly changes in appearance, that in twenty-four hours or less it has become brown or black, and hard outside, and from this chrysalis, or pupa-case, the fly emerges by cracking off one end of its case (customarily) in about four weeks, though it is considered that hybernation sometimes takes place in pupal state.

In regard to some main points in the habits of the fly. From observations taken in the New Forest it appears that these may be found fairly plentiful early in May, when warm sunshine has brought them out from their winter quarters in sheltered places or under bark of old trees. On wild ponies or cattle in the Forest these flies may be in clusters of even hundreds without the animals appearing to mind their presence so long as the flies remain at rest.

The great trouble is in the case of horses unused to the fly attack, which on first infestation by a Forest Fly "have a frightened look, lay the ears back, make short stamps and kicks with the feet; and, if the fly is not taken off, will sometimes kick violently, and even roll." The difficulties from horses unaccustomed to the fly becoming unmanageable on their first acquaintance with it are well known. This fear does not appear to arise from any pain connected with the bite, though the flies are to some degree blood-suckers, as is shown by flies being sometimes found distended with the blood they have taken, and much of the distress and terror is ascribed to the irritation caused by the fly running (generally sideways) amongst the hair, and also by means of its groove-sided claws having such hold of the hairs that the horse is totally unable to dislodge it. With this fly, as well as with one of the Indian kinds, the Dog Forest Fly, *Hippobosca canina*, the tenacity of the grip of the claws on hair is so great that it can peel the outer part of the hair to mere shavings, and the dragging that must take place at the roots of the hairs in the passage of the pest amongst them may well account for the distress on its first experience.

Nothing (so far as I am aware) has been mentioned as to the effect of its peculiar cry as it settles down, but from my personal experience when attacked by a stray specimen in my study, when I was unprepared for its sudden flight at my hair, I should say that the noise was thoroughly startling.

One of the most commonly adopted remedies for attack to unseasoned horses in the New Forest is to damp a cloth with paraffin,

* For figure, natural size and magnified, before complete colouration, and for figure of pupa removed from puparium, see p. 50.

and rub lightly over the animal, particularly the parts beneath and under the tail, which are most subject to infestation.

In the above notes I have only entered shortly on some of the main points regarding this infestation, which I have given in detail at pp. 95–117 of my Nineteenth Annual Report. In this will be found my own observations on the elaborate structure of the foot appendage, and many notes from life regarding habits of the fly and remedial treatment used in the New Forest, as well as abstracts regarding the existence *in embryo* from the observations of Réaumur, and references, confirmatory observations of De Geer, and references to the elaborate considerations of Leuckart, and notes from other entomologists. There I have also given some observations on the Dog Forest Fly, *Hippobosca canina*, Rondani, also of the Indian or Spotted Forest Fly, *Hippobosca maculata*, Leach, which were placed in my hands in the course of the investigations of 1895, and are of considerable interest as being of nearly-allied *Hippoboscidæ*.

Spider Fly; Grouse Fly.

Ornithomyia avicularia, Linn. (= *viridis*, Meigen).

On September 29th I was favoured by Mr. E. G. Wheler, of Swansfield House, Alnwick, Northumberland, with a specimen of a "Forest" or "Spider" Fly taken from a grouse, with the remark accompanying that he forwarded it, as it might be of interest relatively to some difference which he noticed in the structure of the claws of the specimen and those of the nearly-allied Horse Forest Fly, *Hippobosca equina*.

From the wings of the specimen being folded longitudinally under the covering glass of the microscopic slide, it was not possible to investigate the neuration thoroughly, but other characteristic points were so well displayed that (after consultation) there did not seem to be room for doubt that the specimen was *Ornithomyia avicularia*, Linn., sometimes also known as *viridis;* this, more especially as *O. avicularia*, L., is the only species recorded as British in the 'List of British Diptera' by G. H. Verrall, F.E.S., 1888.

On October 25th, in reply to my mention that a few more specimens would be very acceptable if easily procurable, Mr. Wheler was good enough to send me two more, preserved in spirit, with the observation:—

"I have no opportunity of obtaining more Grouse Flies now, and, in fact, think it very probable that they are only about during the hot weather, as they are very active, and by no means easy to catch when they leave their host. . . . I took the Grouse Flies from freshly-

killed birds when driving early in the season. There appeared to be generally two or three on each bird."

Ornithomyia avicularia is of the family of *Hippoboscidæ*, but is distinguishable by several easily observed points from *Hippobosca equina*, noticed in the preceding paper. For one thing, it is about one-quarter less in size than *H. equina* (Horse Forest Fly), which is from three and a half to four lines long, whereas *O. avicularia* (Grouse Fly) is from two and a half to three lines in length. Also, in addition to the compound eyes possessed by both species, *O. avicularia* has three *ocelli*, simple eyes (specks on the top of the head), whereas *H. equina* has none.

There is also a very characteristic difference in the structure of the claws of the two species. In both species each foot is furnished with two claws, but in *equina* each claw is divided into two portions, in *avicularia* into three.

A reference to the figure of the claw of *H. equina* at p. 53 in the preceding paper, and in the frontispiece, will help to make the above differences clear. It will be seen there that the claw of *equina* is divided into one long curved portion, with another, a lumpy obtuse portion, attached, which is about half the length of the curved and pointed part. In regard to *Ornithomyia*, it is mentioned by Dr. J. R. Schiner in his account of the characteristics of this genus,* that "*the claws have two side claws, and thus are three-toothed.*"

On examining Mr. Wheler's specimen with a quarter-inch object-glass, I found the uppermost longest division of the claw rather more slender and flatter than in *equina*, and very sharply pointed; the next division (corresponding with the thumb-like or lumpy division in *equina*) much longer and somewhat narrower in proportion than that of *equina* (about two-thirds of the length of the pointed portion), and very obtusely ended. The third division was not so well defined, apparently from the balsam or preservative medium having soaked into it and made it partly transparent. But this was dark at the base, and where I was able to get what seemed a correct view, it was merely a small body about the width of the other blunt claw, but only about half its length, and ending in a very blunt point, so as to give it almost an oval shape, also there was a raised vein, or ridge, and one or two lesser elevations running along it longitudinally. From want of sufficient specimens to examine, I was not able to make out the nature of this division or lobe of the claw quite clearly, but it appeared as if, although horny, it was not of such exceedingly hard substance as the other divisions of the claw, and I only submit an imperfect description.

* 'Fauna Austriaca (Diptera),' von J. R. Schiner, ii. Theil, p. 646.

The bearded hair, first, I believe, observed by De Geer, and recorded by him as found on this *O. avicularia*, was very noticeable. Of this he remarked in his paper (referred to below*) on the "*Hippobosque verd*," *Hippobosca* (now *Ornithomyia*) *avicularia*, Linn.:—

"Between the '*pelottes*'" [pads or pulvilli] "there is placed a very remarkable bearded hair, having bristles on each side like a little feather, which is attached beneath the foot. We have already mentioned that the *Hippobosca* have a similar hair appended to their tarsi."—(C. De G.)

This bristly hair will be found figured at p. 53, and also in the Plate at frontispiece, as seen on the feet of the Forest Flies of the New Forest; in the case of Mr. Wheler's Grouse Fly, the hair was more curved in different directions, and the side hairs (as seen) were longer and fewer in number; but, as previously observed, the amount to which the side hairs are observable depends to some degree on the nature of the medium in which they are displayed.

I also noticed, amongst the appendages of the claws of this Grouse Fly, the very peculiar structure, figured in the frontispiece, at the base of the claws, as a flat membrane, with a series of slightly curved tubes, or ridges (much resembling what are sometimes known as "pseudo-tracheæ"), on each side of a central longitudinal vein, or tube. In *H. equina* this membrane is in connection with a bulb-shaped organ covered with what appear to be short hairs, which is also figured in the Plate above referred to, and which I have described at p. 101 of my Nineteenth Annual Report, but which I believe had not previously been observed, nor do I know its uses. In the Grouse Fly, as the specimen had not been specially displayed for figuring, I was unable to get a view of the bulb, and, should it be feasible further on in the year, it would be of interest to obtain specimens which would supply material for a fully detailed representation of the claw of *O. avicularia* with all its appendages.

The colour of the fly is very variable, being noted as sometimes of a horn-yellow, sometimes brown or brownish above, and again, in some cases, the lighter parts are entirely green. The wings are tinged with brown, and longer than the abdomen.† The body and legs are bristly and hairy.

The flies are not uncommon, and are parasitical on birds, but often wander to human beings, and settle in the hairs of the head and beard.

Some of the different kinds of wild birds which are mentioned by

* 'Mémoires pour servir à l'histoire des Insectes,' par M. le Baron Charles De Geer, vol. vi. p. 288.

† For detailed description of neuration of the wings of the genus *Ornithomyia*, see Schiner's work, previously referred to, part ii. p. 646.

Macquart as liable to infestation are hawks, starlings, magpies, partridges, blackbirds, larks, redbreasts, and titmice.

Like the *Hippoboscidæ*, the *Ornithomyiæ* are pupiparous, not oviparous (that is, not propagated by egg-laying), nor do they live on their hosts as larvæ, or maggots, but pass this stage in the abdomen of the female, and are deposited at its completion, just at the commencement of the pupal stage. The pupa of *Ornithomyia* is noted by Léon Dufour * as being black, two or three times smaller than that of *Hippobosca*, smoother, and more shining, and of the same general conformation, but *without* the notch at the posterior extremity. For figure of pupa (or puparium †) of *Hippobosca equina*, life size and magnified, see p. 50, preceding.

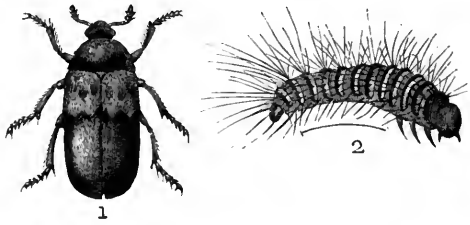
For methods of prevention and remedy, the natural powers of the birds would appear calculated to supply all that is necessary. These Spider Flies have the same power as the Horse Forest Flies of walking with facility and speed backwards or forwards or to either side (*vide* Dufour, previously quoted). But the claws of the insects have not the power of clasping on the quills of the feathers of birds as they have on the individual hairs of horses and cattle, and consequently much irritation must be spared regarding this point. With regard to irritation of the skin from traffic and passage of the Spider Flies, the bird holds the remedy in its own beak and claws; and in Mr. Wheler's notes, at page 57, he mentions the number on each bird as generally being only two or three.

* L. Dufour, "Sur les Pupipares," p. 83.

† The word *pupa* refers to the insect itself in the intermediate condition between that of *larva* and *imago*, or perfect insect; *puparium* is the case or dry skin in which (as in flies, for instance) the change is carried on, but the words are often in popular use not confined to their precise meanings.

LARDER BEETLE.

Larder Beetle; Bacon Beetle. *Dermestes lardarius*, Linn.



DERMESTES LARDARIUS.—Beetle and larva, magnified.

The Bacon or Larder Beetle, which takes its popular names, respectively, from one of its special haunts, and also one of the many substances which it chooses for its attack, is one of the infestations regarding which there is a steady moderate amount of inquiry, but yet with little or no addition to the information which we are already possessed of regarding the destructive habits of the pest, or as to means of prevention. The accounts confirm what we already know of the waste and annoyance caused by this beetle and its maggots as a house or store pest, and suggest that it would be of use for more information of its habits to be generally accessible.

The beetle is of the shape figured above from life (magnified), that is, oval, from a quarter to a third of an inch in length, black in colour, excepting a pale yellowish or brownish yellow band across the lower half of the wing-cases, covered with a thick grey down, and usually bearing three black spots (on each of the wing-cases). Beneath them I find a pair of strongly veined wings. The head is bent down; the antennæ (horns) short, with the clubs at their extremities 3-articulate. The under side of the body slightly clothed with ashy-down or scales.

The larva, or maggot, is about half an inch or rather more in length, dark brown (or broadly striped across with dark brown) above, and thickly covered with brown hairs; under surface white.

The infestation has been known in Europe for more than two centuries, and is now cosmopolitan in distribution; it is found both in Asia and America; and in the United States, where it is as great a pest or even greater than with us, it is now considered that it may be possibly native as well as introduced.

The main points of the life-history, taken from German observation,* are that the beetles develop from the chrysalis state in October

* See 'Praktische Insektenkunde,' by Dr. E. L. Taschenberg, pt. ii. p. 24.

or later, but remain (where they are not in warm quarters) for the winter in their places of development ("Weige," or cradles), and appear early in the following year, often in the first days of April.

Propagation begins about May, when the eggs are laid on such substances as serve the beetles for food, as meat of various kinds, hides, furs, &c.

Dr. Lintner* notes that "there are apparently several broods throughout the year," and that "the cast larval skins, which are thrown off from time to time during growth, often disclose the lurking-places of the active larvæ, buried within the substance on which they are preying."

Of the food of this infestation, Dr. Lintner observes that "it is particularly fond of bacon, although it also preys on other dried meats, as hams, &c., also on cheese, peltry, skins, horns and hoofs of dead animals, feathers, insects in museums, and mounted birds and mammals"; . . . but "it does not eat clothing of any kind unless it encloses or is heavily charged with fatty matter. It is the larva that commits by far the greater depredations, the perfect insect being comparatively harmless, except as it continues the species by the deposit of the eggs."—(J. A. L.)

In the paper by Dr. Lintner, noted above, are references to observations, with quotations from various publications on bee-keeping, showing that *D. lardarius* also feeds on wax, and on dead bees and pollen in the comb; and in an observation quoted from Prof. C. V. Riley (Entomologist to the Department of Agriculture, U.S.A.) he remarks that specimens of the larvæ sent to him fed ravenously on wax, and after changing their coats several times became beetles.

The latest information I am acquainted with as to the life-history and habits of this beetle is that given in the publication referred to below, which brings results of research up to 1896.† Here it is noted that "under favourable circumstances the insect is unquestionably a rapid breeder." An instance is given of an observer having placed a female beetle in a glass jar with a piece of meat, and five weeks afterwards "a large and flourishing colony of larvæ, most of them full-grown," were found.

Quotation is made from Dr. G. H. Horn, in the 'Proceedings of the Entomological Society of Philadelphia' (1861, vol. i. p. 28), who states that the insect remains in the pupa condition for a period

* See paper on "*Dermestes lardarius*" in 'Sixth Report of Injurious and other Insects of State of New York,' pp. 119–123, by Dr. J. A. Lintner, Albany, U.S.A. 1890.

† 'The Principal Household Insects of the United States,' by L. O. Howard and C. L. Marlatt. Bulletin No. 4. New Series. United States Department of Agriculture, Washington. 1896.

varying from three or four days to a week, or even more, depending principally on the warmth of the locality.

I extract the following passage *verbatim* from the U.S.A. Bulletin (referred to at page 61), as it contains very useful information, and, joined to the observations previously given, seems to me to furnish all that we need to know for practical purposes as to the life-history and habits of this destructive pest:—

"From this statement" [that of Dr. Horn, quoted above, E. A. O.] "we see that an entire generation may be developed in six weeks. Therefore the increase of the insect may be very rapid, and there may be four or five generations annually. The larva, when feeding upon dried and smoked meat, according to Dr. Horn, is usually seen creeping on the surface of the meat. For food it prefers such as contains fat and connective tissue, seldom attacking the muscular portions. It does not bury itself in its food until about the time of assuming the pupa state.

"In general the beetles make their way into houses in May and June, and at once deposit their eggs on their favourite food if they can obtain access to it. Where this is impossible, they will lay their eggs, as well as other beetles of the same family, near small cracks, so that the young larvæ when hatched can crawl through. Dr. Riley, in his 'Sixth Missouri Report,' states that fresh hams are not so liable to attack by this insect as those which are tainted or injured."—(L. O. H. and C. L. M. in Bulletin referred to.)

One important point which may be gathered from the above observations is that the customary time of appearance of the beetles which start the summer attack is noted as taking May for its centre, being April and May in the German observations; in May and June in those of the United States; and in one of the observations sent to myself last year (1898) from an old manor house in Leicestershire, the date of appearance coincides with what may be called "average date." My correspondent wrote on May 11th, forwarding specimens which had "lately made their appearance."

One point of the structure of the beetle does not seem to me to be sufficiently attended to in considerations of preventive measures, and that is its possession *of strongly-veined wings*. If it is in the habit of using these for flight, its sudden appearance and distribution is not to be wondered at.

Prevention and Remedy.—One method is enclosing substances likely to be attacked in stout muslin or paper sacks or wrappings, taking care that this is done *in good time*, before the beetles have had a chance to deposit their eggs, and also taking care that there are no cracks or tears in the wrappings through which the beetles may make

entrance for egg-laying. Where the above is not practicable, frequent examination of the meat stores to ascertain whether maggot attack is noticeable would be very desirable.

It has been suggested that where a store-room is infested the contents should be cleared out, and the room "either be sprayed with benzine or subjected to strong fumes of bisulphide of carbon." I should *not* myself like to advise either of these applications on account of the great danger from their inflammability, especially in the case of bisulphide of carbon, which is liable to ignite at a raised temperature, even without the presence of flame, as of fire, candles, &c.

In many cases a thorough good clearing out of the infested larder, or store, and washing and "swilling" floors and every accessible part (especially all crannies) with hot soft-soap and water, as near scalding heat as can be managed, would do much to clear out the infestation, which appears to me (in private houses) to depend very much on the amount of care given to general order as well as to condition of stores. Before bringing back the removed contents of the larder, or other infested rooms, everything should be examined. Meat should be lifted from anything it is lying on, and piles of plates or basins raised one from the other so as to ensure that there are no beetles hidden away among them.

Where the outside of bacon or other meat is found to be maggot-infested on the surface, this part should be cut away and burnt. It has been suggested that the exposed surface should be washed with a *very* dilute carbolic solution. This, if not objected to as giving a slightly peculiar flavour to the bacon or other meat, would almost certainly do good in a remedial point of view.

Nothing (so far as I see) has been suggested as to a treatment which sometimes does all that could be wished in clearing *broadscale* infestations where steam power is available. By turning on scalding steam from an engine at hand it might be certainly hoped that beetles and maggots alike would be got rid of.

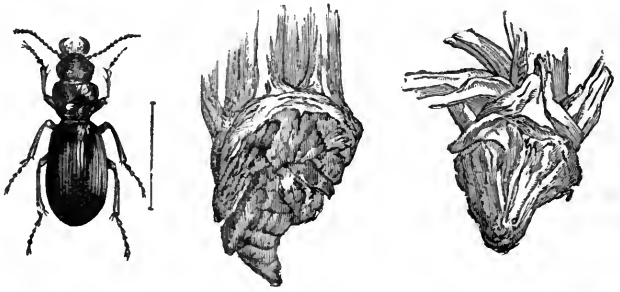
Amongst other methods of lessening attack, whitewashing meat, such as flitches of bacon, has been mentioned; and also trapping the beetles by placing cheese to attract them. This is noted as having proved very successful, the beetles resorting eagerly to the cheese, so that examination, and hand-picking and destroying the creatures two or three times a day, in this case "practically exterminated them."

Where larder or store-room windows are open to the outer air, it might prove serviceable to place screens of fine wire, or netting, or wire gauze to prevent access from the outside at times when the beetles were likely to be, or were known to be, about.

MANGOLDS.

"Ground Beetles."

Pterostichus (=*Steropus*) *madidus*; *P.* (=*Omaseus*) *vulgaris*, Linn.



PTEROSTICHUS MADIDUS, magnified, and line showing natural length.
Mangold roots injured by the beetles.

The attacks of Ground Beetles were first definitely reported as being noticed as a cause of serious injury to Mangold roots amongst the observations sent in 1885, but since then the infestation has been again noticed, until it is obvious that the attack must be looked on as a trouble to which Mangold roots are certainly liable, although not necessarily to the severe extent which the subsequent appearance of the same kind of beetle in Strawberry beds (first reported in 1894) has proved to Strawberry fruit in various localities.*

The kind of attack is of great interest both practically as well as scientifically from the circumstance of the Ground Beetles (*Geodephaga*) being of a class which, till of late years, was supposed to be almost wholly carnivorous in its diet,—that is, to limit its attacks mainly to worms, maggots, or other small animal material,—and, consequently on the first observations of the beetles as seriously destructive to Mangolds and Strawberry fruit, much attention was given to identification to be absolutely certain of the species present.

The first notes of attack with which I was favoured were sent me on June 29th, 1885, by Mr. T. James Mann, from The Grange, Bishops Stortford, Herts, together with specimens of the beetles taken in the act of feeding on the roots of Mangolds at 3 a.m. that morning. A little later on more beetles were sent which also had been captured early in the morning in the act of preying on the Mangolds, and specimens of the attacked roots were also sent as good examples of the

* Observations of successful methods of prevention and remedy of attacks of Ground Beetles to Strawberry fruit will be found further on, under the heading of "Strawberry."

method in which they were eaten off. Two of these roots (figured at heading, p. 64) show the method in which the substance of the root has been gnawed away into pits and grooves by the mandibles of the beetles. The greatest size of root mentioned as being attacked was about five to six inches in length, and an inch and a quarter to an inch and a half diameter at top.

In this case the beetle proved to be *Pterostichus* (= *Steropus*) *madidus;* for figure, see p. 64. This species is from about half to three-quarters of an inch in length, of a shining black in colour, though the legs or thighs are sometimes of a red tint. The jaws are large and curved; the legs long and strong; and it is *without wings*, a very important point in consideration of prevention. This species may be to some degree distinguished from two other nearly allied species, very similar in appearance, by the hinder corners of the thorax not being acute or bluntly pointed, but rounded off, so as to be narrower than the base of the wing-cases (see figure, p. 64).

The injury caused by the attack was at or about ground-level, or a little above it, to the top of the roots, and was sometimes all round what may be called the shoulders of the root, or sometimes on one side, or in patches. In the case of the specimens figured, it will be observed that the roots have been entirely gnawed through. The beetles did not eat the leaves.

The loss was estimated by Mr. Mann, after examination of the attacked crop, to be one plant in every ten; in one part of the field, one in every five.

From the fact of the beetle being a night feeder, its presence as the cause of mischief is very apt to be overlooked, as very few observers are disposed, even on summer mornings, to be so early on the alert as 3 a.m. so as to secure an observation before the beetles have hidden themselves from the dawning light, in the ground, or under any rough shelter, as dried manure. The field in this case had been manured at the rate of ten loads of farmyard manure, 4 cwts. superphosphate, and 2 cwts. of salt.

The above notes are given once again (in abridged form) as being the first contribution of information sent as to presence of Ground Beetles as a serious infestation to Mangolds, and also as being accompanied with carefully detailed notes of observation of time and method of attack, and with specimens, which enabled trustworthy identification to be made, of the beetles taken in the act of doing the mischief.

Since then, little inquiry has been forwarded as to presence of Ground Beetles, excepting at Strawberry crops, to which, in some localities, they have proved disastrously injurious. Still, enough has been sent to show that the infestation is one which may only too certainly rank amongst our farm attacks; and in the past season I

was favoured by the following observations regarding Ground Beetle attack to Mangold, which were sent me from Brunstead Rectory, Stalham, Norfolk, by the Rev. Maurice C. H. Bird, with specimens accompanying. These proved, on examination, to be of two species of Ground Beetles (*Geodephaga*)—some of *Pterostichus* (= *Omaseus*) *vulgaris*, and some of a smaller kind, which did not differ, so far as I could see, from *Calathus cisteloides* of Panzer. This is only from about three to six lines in length (that is, from about a quarter to half an inch). The colour black, with *antennæ* (horns) and legs brownish red. The thorax slightly narrowed before, sinuated behind, and the hinder angles rounded off. *The wings absent or imperfect.*

Pterostichus vulgaris is six and a half to seven and a half lines in length, or possibly more. Wholly black, and rather shining. Thorax rather broader than long, with the hinder corners bluntly pointed. The wing-cases strongly and smoothly striated. *Wings absent.*

The reader is asked to notice that in the case of each of the three above-named species the wings are either wholly absent or imperfect, as this inability to transport themselves by flight about the country is a very important consideration in regard to prevalence of attack, and success in remedial measures. A figure of *P. vulgaris*, magnified, will be found at heading of the paper on Strawberry attack by Ground Beetles.

Regarding the attack to Mangolds of the above-mentioned beetles, the Rev. Maurice Bird wrote me from Brunstead Rectory, Stalham, first on July 5th, as follows:—

"I am now sending you some Ground Beetles and Mangold plants to show cause and effect, as I believe. This forenoon, my friend Ash Rudd, J.P., landowner and farmer near by, called and asked me to go and inspect his Mangolds. I found fields cropped with most choice varieties, and so most valuable for feeding purposes, *i. e.* those containing most sugar, were chief sufferers, cut off just above ground after the plants had been singled out. I searched deeply and carefully all over several fields, and could find no trace of Slug, Snail, or Wireworm, or Rabbit work, but the enclosed beetles were near by nearly every bitten-off plant. I am aware that they and other allied Ground Beetles are generally supposed to be carnivorous, but think that it was fully proved that they last year spoilt the Strawberry crop in this neighbourhood. Would you kindly give me your opinion as to Mangolds and enclosed beetles?"—(M. B.)

The above note is of a good deal of interest, as coming from an observer acquainted with Ground Beetles and their reputed as well as recently observed habits, and shows an attack of considerable extent characterized by the Mangolds being cut off just above ground; and, what is of great importance practically, that on Mr. Bird searching

"*deeply* and carefully," he found beetles near to almost every bitten-off plant.

This agrees with a note of observation sent me regarding day shelter of Ground Beetles in the case of Strawberry attack:—"The beetles lie round the plant and under the earth, which is covered with straw and litter, having their holes and runs through the earth and litter, the opening being through the litter and just under the bunch of fruit attacked."

Whether this habit can be utilized for remedial measures in the case of Mangolds does not as yet appear. The beetles might presumably be disturbed by hoeing or other agricultural treatment that would go deep enough, and in the case of grubs, or caterpillars, might be hand-picked, or left to be cleared by birds. But the Ground Beetles, with their long and strong legs and power of speedy running, would conceal themselves again in the disturbed soil before there would be a chance of catching any number worth the trouble.

In the case of *Harpalus ruficornis*, a nearly allied and exceedingly injurious kind of Ground Beetle (figured under the heading of attack to Strawberries, further on), I found specimens which I kept under observation were pairing about July 20th. It might certainly be presumed that these would shortly lay eggs, and the larvæ (which are mostly found in the same places as the perfect insects) would soon be found in the ground, and probably those of the other Ground Beetles.

As yet we appear not to have descriptions of their appearance beyond that of the geodephagous larvæ generally. These are described as being usually flat, long, parallel-sided, fleshy, with the head and next segment hard. The three pairs of legs horny, the jaws strong and sickle-shaped, and the caudal extremity furnished above usually with two horny or fleshy appendages, and the lower part lengthened into a kind of "membranous supplemental leg."

The ordinary agricultural treatment of breaking up the ground after the Mangolds have been drawn would probably be about as good a course as could be followed for getting rid of a large proportion of the maggots that were in the land, but we need to know how, in the case of the three wingless kinds of Ground Beetles mentioned above, they become *present* on land not for some years previously to the attack recorded under Mangolds.

The maggots appear to feed on animal substances, grubs, worms, &c., such as were at one time supposed to constitute almost entirely the dietary of the beetles, and as such food is to be found in farm manure, it is certainly open to conjecture that they may be carried in it to the field.

At present, however, much more information on the winter quarters and other points of the life-history is needed before we can

tell how to deal with the beetles as a root crop pest. Should the infestation increase so as to be of more frequent occurrence we might expect, from the size of the larvæ, to be able to gain observations, and to trace the development. At present we have not made advance with remedial measures against them as a root crop pest, but in the past season, thanks to Messrs. Laxton, of Bedford, we have been put in possession of most serviceable information of how to deal with them as Strawberry infestation, which, by permission, I give further on under the heading of "Strawberries."

Pigmy Mangold Beetle. *Atomaria linearis*, Stephens.

ATOMARIA LINEARIS (after Taschenberg), magnified; natural length, one twenty-fourth of an inch.

Atomaria linearis, figured above, is an exceedingly small beetle, only about half a line in length, which has long been known on the Continent as very destructive to Beet or Mangold plants in their early condition by attacking the root, and, later on, extending their ravages to the tender leaves; but it was not (so far as I am aware) until the year 1891 that we had definite record of it as a young-Mangold pest in this country. For some years previous to that date inquiries had been sent me, with specimens accompanying, as to the cause of the mischief to young Mangolds by the roots being gnawed, or, in some cases, the little plants being eaten at ground level, to an extent to cause much damage; but there was no clue to the cause of the mischief, and I believe the first *record* of the infestation as a Mangold pest with us was made by Prof. Allen Harker in 1891, when he noticed an *Atomaria* beetle as being seriously injurious to the Mangold crops at the Royal Agricultural College, Cirencester. On February 27th in the following year Prof. Harker wrote to me:—"I think I mentioned to you that I found myriads of a small *Atomaria* at our Mangolds last spring, when we lost about half the crop." At the same time Prof. Harker forwarded me an extract from the publication mentioned below,* in which was given a description of *Atomaria linearis*, and the method of their ravages, with the remark:—"This most accurately

* 'Cours d'Agriculture pratique: les Plantes fourragères,' Betterave, pp. 33, 34, par Gustave Henze. Paris: Hachette. 1861.

describes the appearance of our Mangolds, and I could have collected hundreds of Atomarias at each plant." In that year, 1892, I had specimens and descriptions of attack to Mangolds agreeing well with descriptions of the method of infestation, and it seems to me that it is this, that is, the appearance of the injuries, that we must *practically* rest on for identification, as few but skilled entomologists could give trustworthy identification of beetles of only the twenty-fourth part of an inch in length.

In 1895 I had notes of this well-marked form of injury being observed by Mr. D. D. Gibb, of Ossemsley Manor Farm, Lymington, Hants, as doing damage to Mangolds; and since then I had no further reports on the subject until in the past year (1898) notes were sent me of similar Mangold attack being observed near Ashburton, Devon, and also near Weston-super-Mare, which I give further on.

The beetle is described by John Curtis, in his 'Farm Insects,' p. 395, as "elongate-linear, slightly pubescent, varying from black to rust colour; head broad and triangular; eyes slightly prominent; horns chestnut colour, as long as the trunk, slender, eleven-jointed, terminated by a three-jointed club; trunk depressed and margined; wing-cases depressed; wings ample; six short chestnut-coloured legs; the feet five-jointed. Length half to two-thirds of a line."

From comparison of various descriptions of method of attack, it appears that the beetle comes out in May and June (there may also be a second appearance in July and August), and by the middle of June the beetles may be found to have been seriously injuring the coming crop by gnawing little holes in the germinating plants, so that they perish before appearing above ground; or, again, by so gnawing round the top of the plant, or eating the lower part of the leaf-stalks below ground level, that the young plants die off. Other mischief is caused by injury to the tap-root, and if the earth is turned back the wounded parts of the root may be found turned black, and the little beetles found at their destructive work, often in very great numbers.

Later on, *especially in bright sunny weather*, the beetles may be found at work on the young leaves, and sometimes causing much mischief; and on warm evenings the beetles come out of the ground, and rising in the air they pair.

The following observations of attack, which agree well with the details we possess of the method of infestation of this *A. linearis*, were sent me in the past season by Mr. C. J. R. Tipper, from the Grammar School, Ashburton, Devon, with beetles accompanying:—

"I enclose specimens of Mangold plants taken from a field of ours which has entirely gone under. The injury appears principally on the roots, which are gnawed nearly through. We fancied at first it

must be Wireworm, but found none of those marauders, but, instead, hundreds of tiny beetles (specimens of which I enclose herewith). Round every root we found the earth swarming, and also found them in the lower parts of the stem, and in the scars on the damaged roots."—(C. J. R. T.)

On June 3rd Mr. James Muir (County Instructor in Agriculture), writing from South Haven, Beach Road, Weston-super-Mare, forwarded me the following observations, with specimens of *A. linearis* (then pairing) sent accompanying, and also a small Mangold plant with the long root injured. Mr. Muir observed that he wrote about an insect attack which had lately been brought under his notice:—

"A farmer in this neighbourhood,—Mr. Hawkings, at Northam Farm, Berrow,—wrote me that his Mangolds were dying off in a patch where they also failed last year. (Having little arable land, he grows Mangolds year after year on the same land.) On visiting the field, I found that a large patch had been entirely destroyed, and that it was steadily spreading. The plants came up quite well, but afterwards appeared to wither and die, and at, or a little below, the surface of the ground looked as if they had been bitten. Enclosed I send you a tube containing an affected plant and several specimens of a small beetle, which I found in considerable numbers in the soil close to every dying plant that I examined."

Mr. Muir expressed his wish for information as to the nature of the attack, and how to stop it then, and to prevent its recurrence, and added further:—

"I should perhaps add that the manure used for the crop was cow-dung applied in the autumn, and salt, superphosphate, and nitrate of soda before drilling. Also that a few Cabbage sown with the Mangolds are unaffected by the attack."—(J. M.)

In both of the above accounts the point of the *great numbers* of these excessively small beetles which were observed round the attacked plants should be noticed, as this is a characteristic of the infestation, even (as Prof. Harker wrote me from the Royal Agricultural College) to being present by "myriads"; and this enormous presence not only accounts for the serious failure of the young crop, but also is apt to set observers astray, for the shape of the insects not being clearly noticeable without a magnifying-glass, the infestation may be simply considered to be a visitation of ants.

We have no notes of observation of where the eggs are laid, or on what the maggots feed. Conjecturally, they feed below ground, for, minute as they must be, still, such a quantity of maggots as there must be to turn presently to such vast numbers of beetles could not fail to cause observable mischief to the young leafage, although they themselves may be hardly observable.

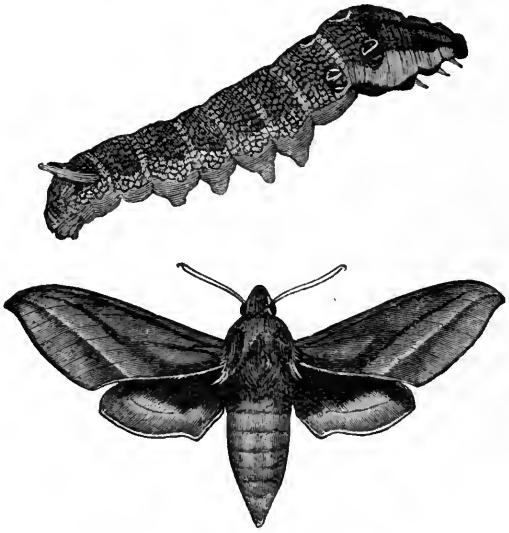
Prevention and Remedies.—In an attack which is so very seldom noticed as this of the "Pigmy" Beetles, it is very unlikely that the cost of preventive measures would be gone to; but the circumstance of *Atomaria* beetles having been recorded as occurring in "vegetable refuse," and also "harbouring in dry dung," may give a clue to localities of hybernation of the autumn or late summer brood, from which they *may* come out in the following spring, in the same manner as "Turnip Flea" Beetles (*Phyllotreta*), to attack the young crop. This, however, like various other points of the life-history of the "Pigmy" Mangold Beetles, we need more information about.

Thick seeding (where attack is considered likely to occur) is a good practice, for thus some part of the plants may survive and give a crop in the case of only moderate infestation.

Thorough cultivation and liberal manuring such as will push on the plants and support them if attack occurs is treatment that will answer in any circumstances; but at present we need more detail of life-history of the beetles to enable us to cope with the attack. Also, up to present date, the attack has so rarely been observed in this country that it does not appear of much practical importance beyond pointing out to us to be ready to meet it, if it should occur to a greater extent.

MURRAIN WORM.

"**Murrain Worm,**" caterpillar of **Elephant Hawk Moth.**
Chærocampa elpenor, Westwood.



CHÆROCAMPA ELPENOR and caterpillar.

During the past autumn I received the following note from Mr. Thomas Wade, of Newcastle-West, Co. Limerick, Ireland:—

"Recently a rather curious case came under my notice here: I was call to see a cow which was suffering. She was standing with her tongue protruding; there was perhaps a little swelling at the back of the tongue. She was breathing sharply and laboured, emitting a groan at each expiration. She was feverish, with a weak pulse. We gave her a dose of linseed oil, and a few drops of tincture of aconite. She gradually recovered, although it took her four or five days. The farmers, not only here, but all over Munster, seem convinced that this illness is caused by 'a worm,' and from their description it is evidently a lizard, or something akin to it, which is taken up by the animal when eating grass, and thus gets stung. I know of nothing which might do it. . . . I should be very glad if you could give us any advice on the matter. I have not a specimen by me of the 'worm,' or I should have sent it you."—(T. W.)

Here, it will be seen, we have a *definite* account of sickness of the animal (giving way to the application of remedies), and also the popular view (to which Mr. Wade does not in the least commit himself

as to it being correct) of the sickness being caused by some small creeping thing taken up by cattle in the grass on which they are feeding.

Now (though not myself qualified to give an opinion on veterinary matters), it chanced that in the year 1887 I received two applications, in each case with specimens accompanying, regarding a very large and repulsive-looking caterpillar, called the Murrain Worm, "sometimes said by popular voice to give the disease called 'murrain' when licked or swallowed by a cow." This caterpillar, on investigation, proved to be the larva of the Elephant Hawk Moth (*Chærocampa elpenor*), and it seems almost certain that the above observations must refer to *two parts of the same attack*. In one case we have the large luridly-coloured grub called the Murrain Worm, and credited with causing murrain in cattle; in the other, we have the precise report of cattle-sickness credited to some small creeping thing swallowed as the origin of the illness.

It may certainly be supposed that the caterpillar is entirely innocent of causing the sickness; but, looking at the circumstance of this larva especially frequenting ditches and feeding on plants that grow by the water, it appears to me very likely that sickness may be caused by poisonous water plants, and the caterpillar, being seen accompanying, be erroneously considered to be the cause of the mischief, and it may therefore be of interest to give some information as to the habits of the caterpillar.

Such details as I have are as follows. In the summer of 1887 Miss Fleming, writing from Derry Lea, Monasterevan, Co. Kildare, Ireland, remarked :—

"There is a very large caterpillar sometimes found here (I have seen it four inches long) which is said by popular voice to give the disease called murrain when licked or swallowed by a cow. The people call this creeping thing a 'Murrain Worm.' . . . The last I saw was on the approach, travelling as if it was running for its life."

On August 7th (in the same year) Miss Fleming forwarded me a specimen of this so-called "Murrain Worm," which turned out to be the caterpillar of the "Elephant Hawk Moth."

On August 20th another specimen of the same kind of caterpillar was sent me by Mr. N. Richardson, from the Estate Office, Castle Comer, Co. Kilkenny, Ireland. This was beginning to spin itself up in a light web, and the figure of the caterpillar at p. 72 gives a very good idea of its strange shape. The larva is three inches, possibly more, in length, and *when extended* the front segments taper rapidly to the head, but it has a power of retracting the head and the first and second segments immediately behind it into the third, which is then puffed out, and the strange shape, added to the frequently peculiar

colouring, thus gives a very repulsive (to some people, alarming), look to the creature.

The colouring is sometimes brownish buff at the folds, with a net-work of blackish freckles, excepting on the three segments behind the head; these have a band along the side of dusky buff, enclosed in a blackish border, which on the furthest of these segments from the head swells out into a darker blotch. The head and a small curved roughish horn only about a line long, placed above near the caudal extremity, are black. The under side of the grub is buffish, freckled with a smaller pattern than that on the back. The other variety has the ground colour dull green.

The three excellent coloured figures at plate xxv. of the work mentioned below * give life-like representation of the caterpillar, with a figure of the pupa accompanying; and in the paper on this *C. elpenor*, at pp. 113–115, in the volume referred to, will be found detailed information regarding the markings of the larva, and various useful points of its life-history, especially as to the nature of its food-plants. Mr. Buckler's notes of these, when the caterpillars are feeding in natural circumstances, show these to be plants that grow by the water, of which the "Great Willow Herb" (*Epilobium hirsutum*) and the "Marsh Bedstraw" (*Galium mollugo*) are particularly specified. Also a quotation is given by Mr. Buckler from Albin, showing the predilection at least of the larva for watery localities, namely, that "there is something in this caterpillar very remarkable, *viz.* his dexterity in swimming, for, commonly feeding in or near the water, if at any time he happens to fall in, he turns himself on his back, and swims with his head and tail turned together till he gets hold on some part of the plant, by which he helps himself up again." This may or may not be correct, but the *fact* of the caterpillar feeding on plants growing in or near water is very important practically.

When full-grown, the caterpillar spins a web (such as was being begun by one specimen sent me) of an open but strong net-work "on the surface of the soil, sticking in dry leaves and bits of earth, &c.," in which it changes to the chrysalis; this is somewhat over an inch and three-fifths in length, the ground colour light buff, variously marked with blackish or smoky colour, and with the abdomen ending in a triangular curved spike.

The moth, to which this develops (figured at p. 72), is a pretty creature. The thorax and abdomen olive coloured—the first with four pink lines, the latter with three broader stripes running lengthwise; the fore wings olive, with transverse bands of pink; the hind wings of a deeper purplish pink, with base and fore edge of a blackish tint.

* 'The Larvæ of British Butterflies and Moths,' by the late William Buckler. Vol. ii. London: Printed for the Ray Society. MDCCCLXXXVII.

The moth is rather common in some localities, especially in the south of England.

Methods of prevention and remedy are not needed with regard to these caterpillars; but—looking at the widespread belief of illness to cattle being caused by their eating some small creature or caterpillar, which, when sent for identification, proved to be the larva of the Elephant Hawk Moth, which most especially feeds on plants growing by ditches or in wet places—it would appear to be worth while for some qualified observer, when opportunity should occur, to find whether the illness—the so-called "murrain"—may not be attributable to *some poisonous water-plant*, which, if known of, could be removed.

In the paper entitled "Two Poisonous Plants," by the Consulting Botanist of the Royal Agricultural Society (see Journal of Royal Agricultural Society of England, Third Series, vol. ix. pt. iii. p. 561), will be found an account of deaths of cattle and sheep, accompanied by symptoms agreeing with what had been previously observed in cases of eating the tall-growing umbelliferous plant popularly known as Water Dropwort, or Water Hemlock, scientifically as *Œnanthe crocata*, Linn. Plants of this were found in the ditches to which cattle had access. What plant or other evil may be the cause of the so-called "murrain," remains to be seen; but this widespread trouble, which more or less appears now to have given disturbance for at least twelve years, would certainly be worth some skilled investigation as to means of prevention and remedy.

NUT.

Hazel and Filbert Bud Mite. *Phytoptus avellanæ*, n. sp., Nalepa; *Phytoptus vermiformis*, Vallot, Targioni-Tozzetti, Nalepa.*

The swelled and deformed bud growths on shoots of Filbert and Hazel Nuts, caused by *Phytoptus* presence, are not often the subject of inquiry; but from their great similarity in shape to those of the Black Currant, they are so apt to be attributed to mischief caused by the Black Currant Mite (*Phytoptus ribis*), that some reference to them seems needed.

The infestation appears to be becoming rather more prevalent during the last few years, but, from the less favourable circumstances

* For figure giving a very correct *general* representation of the form of the female Nut Bud Gall Mite, see that of Currant Bud Mite, p. 34.

for propagation afforded by growth of Nut bushes to that of Black Currants, it may well be hoped that the infestation will not prove such a disastrous scourge.

One of the worst cases of infestation of Filberts which I have myself seen was where the bushes appeared to have been neglected for several years, and were overhung by trees; and also on a hedge where the Nut bushes had been trimmed back so as to have many shoots; and where they were in a damp locality between a willow ground and a shady lane, I have seen the galls in profusion.

The attack is very similar to that on the Black Currants, for figure of which see p. 34. The infested buds similarly develop into swelled knob-like form, which may be described as a spherical growth, consisting of an abnormal number of bud-scales and abortive leaves, which are thickened in structure, and more or less sprinkled with hairs or other excrescences. The progress of the plant injury is also similar to that of the Black Currant attack. The deformity of the infested bud is advanced so far as to be observable early in the spring, and later on the galled buds, having attained their full growth, dry up and perish, and with the growth of the Nut shoots in July and August, a new growth of galled buds commences.

The life-history of the Mite, or *Acarus*, which gives rise to the bud-galls, is similar to that of the Black Currant Gall Mite. It belongs to the *Phytoptidæ*, which differ from the other divisions of the great order of *Acarina*, of which they are one of the families, in being more or less elongate and cylindrical in shape, and also in possessing throughout their lives only four legs. Propagation is by eggs. After passing under various appellations, including for a while (when considered to be a distinct genus) that of *Calycophthora avellanæ* of Amerling, the species is now placed amongst others of the genus *Phytoptus* as *Phytoptus avellanæ* of Nalepa, and it may also be referred to as *Phytoptus vermiformis* of Vallot, Targioni-Tozzetti, and Nalepa. The deformed growth of the Nut buds was known of by Vallot as long ago as the year 1834.

The Mites are too small to be distinguished by the naked eye, and, both in shape and size, resemble those of the Black Currant, *Phytoptus ribis* (of which a much magnified figure is given at p. 34), so greatly, that for all practical purposes this figure is sufficiently descriptive.

The shape is cylindrical, occasionally spindle-shaped. The females attain a length of 0·21 millimètre, the males of 0·18 millimètre—that is, of twenty-one hundredth, and eighteen hundredth of a millimètre respectively; and a millimètre being the twenty-fifth part of an inch, it is obvious that about a fifth part of that measure cannot be clearly distinguished by the naked eye. The fore part of the body is

somewhat triangular, rounded in front, and beneath the body, quite at this extremity, are placed the two pairs of legs.

Those who desire the fullest and best possible account of the characteristics of this species will find it, accompanied by greatly magnified figures of the male and female Mite, and also a sketch of Mite-deformed buds, in the work by the great writer on this division of *Acarina* referred to below.*

The methods of prevention and remedy are on the same principle as those for Black Currant Mite in respect of getting rid of the infested Mite Galls; but from the different method of growth of the Nut bushes to that of the Black Currant, there must necessarily be some difference in the details, as of pruning, &c., by which they are carried out. All information available up to date regarding *Phytoptus ribis*, and possible methods of prevention and remedy, will be found in the Appendix to my Twenty-first Annual 'Report on Injurious Insects,' pp. 141–158.

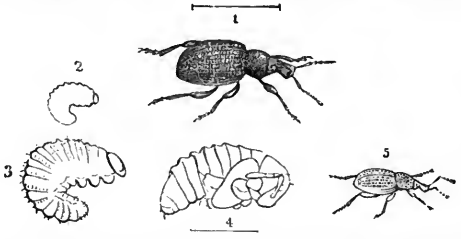
ONION.

Notes of considerable interest regarding maggots of the small beetle *Anobium paniceum*, infesting Onion seed exported from England to South Africa, will be found under the heading of "Seeds, Stores, and Wood," some of the species of *Anobium* being very general feeders.

* 'Beiträge der Systematik der Phytopten,' von Dr. Alfred Nalepa, pp. 15–18, pl. ii. figs. 1, 2, 3, of male and female *Phytoptus;* and pl. iii. fig. 3, of deformed buds. Wien, 1889. Information will also be found regarding the infestation under the synonym of *Phytoptus coryligallarum*, Targ., in the 'Prospetto dell' Acarofauna Italiana' of Prof. Giovanni Canestrini, parte v. p. 611, tav. 52, fig. 9. Padova, 1892.

ORCHARD AND HOPS.

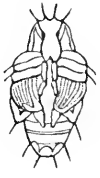
Clay-coloured Weevil. *Otiorhynchus picipes*, Fab.
Red-legged Weevil. *O. tenebricosus*, Herbst.



OTIORHYNCHUS PICIPES and O. SULCATUS.—1–4, *O. sulcatus*, maggot and pupa, natural size and magnified, or with lines showing natural length; 5, *O. picipes*.

The great injuries and losses caused by *Otiorhynchus* weevils have been referred to so often under the headings of the different kinds of fruit crops to which they are injurious, that it would hardly seem worth while to notice them again, excepting that, besides inquiry being sent as to the life-history of the Clay-coloured Weevil (*O. picipes*) and means of stopping its depredations on Apple, Plum, and Gooseberry, notes were sent from two inquirers regarding this kind as doing serious mischief in Hop grounds.

This beetle, figured above, life size, at "5," is about a third of an inch in length, wingless, yellowish or reddish brown or testaceous in colour, and mottled with patches of brown or grey scale, so that when only slightly magnified it has almost the appearance of clay adhering to it, whence its common name of the "Clay-coloured Weevil."



O. picipes.—Larva, nat. size; pupa, nat. size and magnified.

The maggots are legless, whitish, fleshy, and somewhat hairy (see figure, after Curtis, accompanying), with yellow or ochrey heads and jaws. They may be found in the ground by the plants on which the beetle feeds from about August till spring, when, about April, they turn to chrysalids (see figure, magnified). The depth at which they are to be found appears possibly to vary with the nature of the ground, but to be generally not far from the surface; and the chrysalids are very like the beetles in shape, but whitish or yellowish in colour, with the forming limbs folded beneath them (as figured), and without power of movement until the complete development to beetle state takes place,

which soon occurs. The eggs are laid a little below the surface of the ground.

The first note regarding the presence of this species on Hop was sent me on June 11th from Badshot Farm, Farnham, Surrey, by Mr. H. Gardner, with a large number of specimens of *Otiorhynchus picipes* accompanying, and a request that I would suggest some method of destroying the weevil "in the ground sent herewith."

Mr. Gardner mentioned that the first traces which he had seen of them was in the previous year (1897) in a piece of young Hops, but this year (1898) they seemed to be much stronger, and were spreading to a great extent in the Hop-ground, and there was reason to fear that if something was not done the whole garden would be destroyed.

In Mr. Gardner's reply to such information as I was able to give, he favoured me, on June 28th, with the following note, which I take leave to insert in the hope that it may be of some service:—

"The only practical way I found to deal with the weevils was as follows:—Select what bines had not been injured and lay them out on the ground, as they were much safer there than up the poles. Then stripped all the leaves off, and searched closely around the crown of the hill, cracks in the poles, and under any bark on the poles, sometimes finding as many as twenty-five on a hill, and at the same time stopped the cracks in the ground and around the poles; then put a few leaves on crown of hill with a stone on top of them; put the bines up the poles, and searched the hills daily, till at last we could scarcely find one in an hour. It has been a most expensive job, but, as there are seventeen acres of Hops in the field, it was a serious matter."—(H. G.)

The above, it will be seen, is a plain commonsense application of the principle of trapping these *night-feeding* beetles, which hide anywhere convenient to themselves during the day. Several other methods of arranging shelters under which they may creep and thus be readily collected together for a morning clearance are given further on; but there appears no reason why the great Hop leaves, which are at hand, without outlay in collecting or fetching, should not answer excellently, when weighted down as above mentioned.

On May 14th another communication was sent, with specimens of *Otiorhynchus picipes* and of injured bine accompanying, from a firm in the Borough, with the observation:—

"We send you by post a sample of a new enemy to the Hop farmers. Can you kindly inform us how to get rid of the pest? They eat the bine (as per enclosed sample), and you will see they are most destructive just at the present period of the year."

In the case of many of the fruit trees or lower growing crops which are attacked by these weevils, the surest way of getting rid of them is

based on the circumstance of their falling down when they are out at feed *at night* if a light is suddenly flashed on them, more particularly if the plant (as in Raspberry growing), or the infested bough, is sharply jarred at the same time. If a tarred board or tray is held below to catch the falling beetles, two men may thus clear the pests by thousands, one holding the tarred board, and the other flashing the light and jarring when the board is in readiness below to receive them. Whether this plan (or a modification of it of holding an insect sweeping-net below *part* of the infested plant, and thus collecting large numbers of the weevils by successive applications) would answer with Hops does not seem at all sure, but there are various other forms of Mr. Gardner's plan of trapping which might be worth trying as being effective with other crops without so much trouble in preparation.

One plan consists in smoothing the ground round the infested plants, and then laying some large clods of earth about; under these the weevils are found in large quantities on the following day, and can thus be collected and destroyed. Pieces of board, or tiles, will answer as well, or probably any waste material, such as useless pieces of sacking, so long as there was no smell about it that might be repulsive to the beetles, and which gave a dark place of shelter. In the course of the past season, amongst observations sent of successful treatment in getting rid of this kind of weevil from young orchard trees, the plan was mentioned of putting down small pieces of "bagging" every few yards, and examining them every morning.

The great difficulty in treatment in the case of Hop-grounds appears to be how to smooth the ground and fill up the cracks in or by the Hop-hills, so that there should not be clods for the beetles to shelter under, or crannies for them to go down into, and so evade the trap-shelters. In Mr. Gardner's plan (see p. 79), it will be seen he attended very carefully to this point.

In regard to getting rid of the maggots, it has been found that a strong solution of ammoniacal liquor, and common agricultural salt has been of service in preventing increase of the infestation; also kainite, which sometimes answers excellently in destroying small larvæ lying near the surface of the ground (for reference, see Index), might be of service. But not having myself personal knowledge of Hop cultivation, I only make the suggestion as to possible use of dressings under submission, lest they might injure the Hop roots.

The maggots lie near the surface of the ground by the food-plants of the beetles during the winter, and are large enough to be observable if carefully looked for by someone *interested* in the matter, and if the surface of the hills could be safely disturbed during the winter, so that the infested earth could be thrown aside and exposed to

frost and wet, probably a large proportion of the maggots would be got rid of.

The attacks of this species to leafage and of the maggots to roots of the plants on which the beetles feed (and especially their injuries to Raspberry plants), with preventive measures, have been entered on before, as also those of the somewhat larger kind, *Otiorhynchus sulcatus*, figured in its three stages, magnified, at p. 78. This is distinguishable from *O. picipes* by being between a third and half an inch in length, and the general colour being of a dull black; the wing-cases rough, with several raised lines, and spotted with pale hairy tufts. The body between the head and abdomen is granulated, and, *like other Otiorhynchi*, the head is furnished with a short proboscis, and the *wings are wanting*.

This kind is known as the Black Vine Weevil from its colour and from its especial infestation of Vines, and is very troublesome also to growers of Maidenhair Ferns; but, though very injurious, even to the extent of sometimes attacking Turnip crops, it hardly reaches the previously named kind, *O. picipes*, in its vast powers of destruction. The method of life and means of prevention and remedy of both kinds are similar, and so also are those of the kind mentioned below, the "Red-legged Weevil," scientifically *O. tenebricosus*. This species is distinguishable from those above mentioned (when fully developed) by having the wing-cases dotted over with spots of delicate yellow down, but when these are rubbed off the beetle is of a shining black. Sometimes, whilst still immature, it is of a reddish pitchy colour. The wing-cases are united to each other, and the legs are generally of a bright chestnut colour.

This kind was said by John Curtis to be very hurtful to orchard and bush fruits. The beetles are stated to feed on the leaves and young shoots of Plums, Apricots, &c., and the maggots have been found to do much mischief at the roots of bush and ground fruits, as Raspberries, Strawberries, &c. But I have only twice had notes of it as destructive: once in 1883, when I had specimens of it sent me by Prof. Allen Harker as doing mischief to leaves of Strawberries at the Royal Agricultural College, Cirencester (see my 'Handbook,' p. 214); and in the past season as destructive to Pear leafage.

On May 5th, Mr. T. Woods, writing to me from Gillingham, Dorset, with specimens accompanying, remarked:—"This is the third year in succession that the enclosed insect has attacked a young Pear tree growing against the brick gable of a house; it feeds on the leaves."

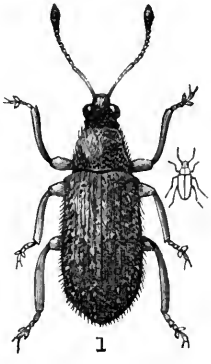
The general means of prevention and remedy for infestation of this species are similar to those for *O. picipes;* but where (as in the above instance) the attacked tree grows against a wall, care should be

taken that the "pointing" of the wall, whether it is of brick or stone, is in good order. Crevices where mortar has fallen out of old garden walls often swarm with *Otiorhynchus* beetles; and with regard to the Pear tree above noticed, as it is mentioned that is a "brick *gable*" against which it grows, very probably there may be pointing or plastering needed beneath the tiles, or between the tiles and the top of the wall, to prevent the weevils having the convenience of a shelter for the daylight hours at hand.

Where attack on wall trees has to be guarded against, the state of the ground at the foot of the wall requires examination, both as to it being a possible day shelter for the beetles during the time of their attack, and likewise a nursery-ground for the maggots during the winter.*

Oblong Leaf Weevil; Downy Brown Leaf Weevil.

Phyllobius oblongus, Linn.; *P.* (*Nemoicus*) *oblongus*, Stephens.



PHYLLOBIUS OBLONGUS, magnified and natural size.

The Brown Leaf Weevil, figured above, is only about the sixth of an inch or a little more in length, and somewhat elongate or parallel-sided in shape. The head and thorax are usually black; the wing-cases variable in colour, pale dull red or brown, with the margins often black, or sometimes they may be entirely pale,—my own specimens, from Kent, have been with reddish wing-cases and black borders, also I have them with reddish brown, and yellower brown elytra, without borders; the head, thorax, and wing-cases are covered more or less with a rather long *grey pubescence*. The antennæ

* The attack of *O. picipes* is entered on at length in my 'Handbook of Insects Injurious to Orchard and Bush Fruits,' pp. 210–216, relatively to its harmfulness as a fruit pest; but it is referred to again above consequently on its being noted as a troublesome Hop pest.

(horns) are twelve-jointed, and elbowed; the club elongate ovate; the proboscis short; eyes rather prominent; legs yellowish or brown. This kind differs from the *Otiorhynchus* beetles mentioned in the preceding paper in *being winged*.

From other species of *Phyllobius* beetles, which are for the most part beset with *green scales*, it is easily distinguishable by the *grey down* on its wing-cases.

Like others of the genus which feed on the leaves of trees and bushes, and sometimes do great mischief to orchard leafage, these have been especially reported as doing harm to Apple and Pear in the more southerly part of England; and in the past season Mr. James Thorpe, of Coddington Hall, Newark-on-Trent, was good enough, on May 30th, to forward me the following note from his gardener at Ardbrecknish, eleven miles from Inverary, Argyllshire, which adds a very northern locality to those troubled by the infestation of this species:—

"*Ardbrecknish, May 28th.* — The beetles still keep coming in swarms, although I have killed thousands. I have given them a double strength of 'Gishurst,' four ounces to the gallon; this did for a good many: they don't mind soot or lime. Last night I boiled a lot of water, and after syringing they came on the ground; having the water boiling, I put it on them with a fine rose. This cooked them, so I shall do this every night. I hope we shall be able to keep them from the other trees; they have not got beyond the door yet. They are very hard to kill."—(H. Toogood.)

In Mr. Thorpe's letters from Coddington Hall he mentioned that the attack did not seem to be known in this part of the country; but he remembered that one of the Apple trees in Scotland was stripped of its leafage in 1897, and that doubtless the beetles had bred again in increased numbers. The attack reported was on Apple trees.

The method, as described, of destroying the vast number of beetles syringed down seemed to be effectual and practicable without any great expense; my only doubt about it was how far the scalding water might affect the roots of the Apple trees which lay near the surface. But as, after the application by a rose, and also after sinking some little way through the ground, the water would not be in absolutely boiling state when it reached the rootlets, it might fairly be hoped it would not hurt them; and there is certainly very great horticultural benefit in an application which can be used on ground (not cropped) beneath the trees as a broadscale treatment sure to kill the pests before they can fly away.

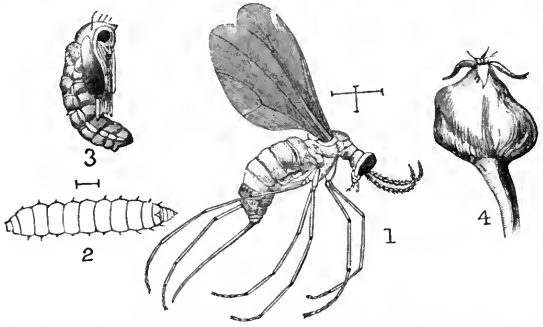
Mr. Thorpe mentioned also that his gardener at Coddington Hall considered an application of paraffin, one wine-glass to two gallons of water, likely to be of service. This he was in the habit of using to prevent attack.

In grass orchards the only way of lessening infestation when present appears to be beating down the beetles on tarred cloths placed below; this answers to some extent in lessening the vast numbers of the nearly-allied bright little golden yellow, or bluish, or green beetles, *Phyllobius maculicornis*, which sometimes infest the leafage of orchard (as well as other) trees. But this shaking down should be done in the morning or evening, or when the weather is dull and still, or else, if the sunshine is bright with a warm temperature, the beetles may very possibly take wing, on shaking being applied, instead of falling, as was intended, on the tarred cloth below.

In regard to the life-history of *P. oblongus*, it is considered that the female lays her eggs in the earth during June, and that the maggots hatched from these feed on the roots of different kinds of plants, and after passing the winter in the ground come out in beetle state in the following spring, but as yet no observations of this part of the life-history of the infestation, as noticed in this country, have been contributed.

PEAR.

Pear Gnat Midge. *Diplosis pyrivora*, Riley; *Cecidomyia nigra?*, Meigen and Schmidberger; *C. pyricola?*, Nordlinger.



DIPLOSIS PYRIVORA.—Female, magnified; lines showing natural size. Larva and pupa, magnified. Abortive Pear. Gnat and pupa, after Prof. Riley.

During the past season the attack of the Pear Gnat Midge has been more prevalent and seriously injurious to the young fruit than in any year since 1883, when its presence was first entomologically recorded, though not to any great extent, in this country.

The dates of inquiry ranged from May 13th to June 16th, and the localities written from ranged over a considerable area of the more

southerly part of England. These were from near Truro, in Cornwall; Calne, Wilts; Glewstone, near Ross, Herefordshire; Evesham, Worcestershire; from near Leicester; from Cambridgeshire near Newmarket; from Polegate, Sussex; and a note was also placed in my hands by an entomological observer mentioning that "the Pear Midge seems very bad this year, especially in Herefordshire."

Preceding the inquiries sent whilst attack was in progress (with specimens accompanying), I was favoured early in the year by Messrs. R. and B. Bomford, of Pitchill, near Evesham, in the course of communication as to preventive measures in the coming season, with the following report of the attack as they had observed it, which gives such a plain and serviceable account of the general features of the infestation that I copy it *in extenso*. On February 7th Messrs. Bomford wrote as follows:—

"Your description of the maggots is exactly as we have noticed, except that we have not seen them jump about. The attack commences whilst the blossom is still out; the Pears swell up to the size of a sparrow's egg, and if you cut them open just below the eye or blossom, you find about a dozen of these small maggots. In about a week or fortnight the Pear becomes black where the maggots have eaten the inside away. The maggots then disappear, the Pear sometimes falling to the ground; much the greater part fall, but some of them stay on the tree, and come to deformed fruit, quite useless. We do not find any difference in the attack on pasture or cultivated land. We have purposely had sheep under the trees when the Pears fall, thinking they would eat up the Pears, and so destroy the maggots; but we have not found this successful, as some of the maggots evidently fall direct from the trees."—(R. and B. B.)

On May 13th (the earliest date of inquiry as to attack then in active stage sent me) I received the following inquiry from Mr. H. H. Williams, of Pencalenick, Truro, Cornwall:—

"Could you kindly tell me if it is possible to prevent the attacks of the insect which has got into the young Pears I enclose? Last year I picked and burnt all diseased fruits, and this year it does not seem quite as bad. I noticed that one lot of trees which was heavily limed on surface (quick-lime) last autumn have not suffered nearly as much as another lot which were not dressed with lime. Is there any connection in this between cause and effect? Trees on walls seem practically to escape altogether, while by far the worst affected are some grown under a wire fruit cage, Raspberries, Currants, &c., being grown between the rows. Can this be due to the absence of birds? I enclose half a dozen samples of the diseased fruit."—(H. H. W.)

The samples sent showed *Diplosis pyrivora* attack still in early stage. The grubs in some cases were still very young, and the inside

of the little Pears injured by being gnawed into little hollows, or cells, and galleries, but the inside not as yet gnawed out into a blackened cavity.

On May 16th, specimens showing attack of this Pear Midge—that is, of *Diplosis pyrivora*—were sent me by Mr. H. F. Getting, from The Gardens, Glewstone, near Ross-on-Wye, Herefordshire, requesting information as to the cause of the small brown or dark velvety-looking spots on the small Pears enclosed.

On May 30th, Mr. Benjamin Bomford again communicated with me, from Evesham, as follows:—

"I have delayed writing to you respecting the Pears, hoping to have a better report to send from the late blossoms, but I am sorry to say we have a complete failure again this year. I posted you some specimens, from which you will see how bad the attack is."—(B. B.)

These specimens, which I received a day or two previously, consisted of five bunches of little Pears, from three to five in a bunch, the largest of the Pears being about five-eighths of an inch across, and three-quarters long.

Many, if not all, of these were distorted in growth,—some lumpy, some contracted on one side and swelled out on the other; and of those that I cut open, fifteen or more showed infestation within. The maggots were of various sizes, from about two-thirds to apparently full grown, and were lying in the gnawed and blackened centre of the Pear. The part between this and the calyx end of the little Pear was also more or less infested, but not the part towards the stem end.

It was difficult to count the number of maggots that might be in one Pear with certainty, as they were much injured in cutting the little fruit open; but I found up to about a dozen in one *half*-Pear. The maggots were in active condition, and dispersed themselves on the paper on which some of the Pears were laid, as if endeavouring to bury themselves.

Most of the Pears were spotted with black, or some had much of the skin discoloured and injured in texture, as if it was drying up preliminarily to the cracking of the fruit, which often takes place consequently on this maggot infestation. In two or three instances the small cracks were already beginning to open.

On June 6th I was favoured by a communication from Mr. Geo. Brown, of The Gardens, Bowood Park, Calne, Wilts, relatively to the nature and means of prevention of an attack to young Pears, of which samples were sent accompanying, and by which very many of the Pears were said to be infested. This attack was also of the Pear Gnat Midge, *Diplosis pyrivora*.

Of above thirty or more Pears sent me (all of which I opened), I found all excepting one were infested. In many cases the attack had

been completed, and the maggots gone. In most cases a great part of the inside of the Pear was hollowed out, or decayed, consequently on the attack. The decayed part sometimes reaching across the Pear, and often making a damp, quite soft, decayed condition on part of the side of the Pear through which it was presumable the maggots had made their escape. Some, I found from examination, might very probably have escaped by the communication of the infested decaying and gnawed portion of the inside of the Pear with the opening at the calyx end of the Pear. The maggots appeared to be mostly fully grown, and I counted their numbers up to about six and twenty in two of the Pears which I examined. They were very active, and their skipping powers were very noticeable as they dispersed on the dark red and black tablecloth of my study table.—(E. A. O.; June 7th.)

The following notes, showing presence of severe attack of the Pear Midge maggot on trees where there had been some small amount of infestation in the previous year, were sent me on June 9th by Mr. F. W. Thomas, from Wannock Gardens, Polegate, Sussex, with specimens accompanying:—

"I am sending you some Pears which are attacked by a maggot which I do not know. Last year a few of the Pears on the tree affected turned black, and fell off. . . . On examination to-day I find that the whole of the crop, and also of other Pear trees close by, are attacked by these maggots; not one fruit is good. . . . The Pear maggots, when placed on the table, have the power to jump."—(F. W. T.)

The specimens, about twenty in number, showed attack of *D. pyrivora* similar to other little Pears sent. Some of the Pears were advanced to about an inch in length, and the maggots were leaving, or had left, some of them.

On June 13th Mr. Thomas further wrote:—

"I have done as you suggest, and have gathered all the fruit I can find affected; most of my trees are young, and so I have no difficulty in gathering the fruit; but I am sorry to say I find other trees attacked (although not so badly) in different parts of my garden. I am inclined to think that the maggots sometimes leave the Pears before they drop, as I find a good many still on the trees, but the maggots are gone."—(F. W. T.)

On June 9th a small consignment of Pears was forwarded to me by Mr. W. H. Hall, from Six Mile Bottom, Cambridgeshire, with a request for information as to the nature of the attack.

In this case the samples were in various stages of infestation of *D. pyrivora*, from the early condition of being simply chambered about the centre by the maggots up to the completed destruction in which they had almost entirely left the Pears. The Pears were about

three-quarters of an inch long; in some instances the outsides were in large part blackened, in some the patches were grey, and the skin of them roughened, but not yet turned black.

On June 15th, in a note on some other natural history matters from Mr. Fred. V. Theobald, F.E.S., he incidentally mentioned that the Pear Midge infestation appeared to be very bad, especially in Herefordshire; and also that he had found that they laid their eggs in the open Pear blossoms, as well as in the unopened blossom-bud, which is the usual method as hitherto recorded.

The latest date of observation of attack which was sent me was June 16th, when some samples of little Pears affected by the Pear Gnat Midge were forwarded me by Mr. J. Lansdell, from The Gardens, Barkby Hall, near Leicester, with the following remarks:—"I enclose some Pears, which, as you will see, have several little grubs inside them. Our Pear crop is suffering severely from this pest." Inquiries as to the nature and treatment desirable to prevent recurrence of the pest showed that it was a newly observed trouble.

Summary of the above.—Taking the information contributed above *in details* of various parts of the attack as given in the accounts of the observers, or shown by their specimens *as a whole*, it will be found to give a correct and clear description of method of damage.

We have observation of the injury commencing on the unopened bud or blossom, and the young Pear, consequently on the presence of the maggots, which may be found up to as many as over two dozen in one fruit, becoming checked and more or less deformed in growth, which may reach (before it is totally ruined) three-quarters of an inch, or perhaps more than an inch, in length.

The presence of the mischief that is going on inside is shown outside by black or grey patches of greater or less extent, and sometimes by the discoloured skin being injured in texture, as if drying up preliminarily to the opening of deep cracks, which are not uncommon in the maggot-infested Pears. Mention is also made of the damp decay which sometimes accompanies the advanced state of the black blotches.

Regarding internal characteristics, we have notes of the maggot-workings, from the early condition of attack of the young Pear when only chambered around the core, up to a great part of the fruit being hollowed out or decayed consequently on the maggot injuries, this decay sometimes spreading all across the little fruit.

Notice is also taken of the escape of the maggots being from the Pears whilst still hanging on the trees, as well as after it has fallen in consequence of its ruined condition; also any means of exit may serve the purposes of the maggots, as through the openings afforded by the cracks in the fruit, or by passing out from the infested portions

through the opening available at the calyx end of the Pear. The power of the larvæ of skipping about like Cheese Maggots is also noticed.

The midge which causes the mischief is a very small two-winged gnat-like fly, only about one line (the twelfth of an inch) or a little more in length of body; the general appearance greyish or black. More in detail, when seen much magnified, and as described by Mr. Meade from his own very complete observations, the head is black, with a patch of yellow hairs, on the top of which some come forward over the eyes. Antennæ (horns) yellowish brown, in the male about one-fifth longer than the whole length of the insect, in the female "about two lengths of the insect without the oviduct." Thorax (body between the wings) black, and, like the face, with grey reflections; and seen "from before, the hind part looks ash-grey, while the front part appears divided into three wide black stripes or patches, of which the middle one is triangular in shape, with a broad base in front, and tapering to a point behind where it joins the scutellum." On each side between the central and side black patches is a row of bright yellow hairs; but "viewed from behind, the whole thorax looks grey." A long tuft of yellow hairs is placed above and in front of the root of each of the wings, and the front edge of the thorax is covered with short yellowish hairs. Abdomen dark brown, clothed with long whitish hairs. Halteres (poisers) with yellowish stalks and clear white knobs. Wings dusky, clothed and deeply fringed on the hind margins with black hair. Legs brown, clothed with white hairs, more dense on the under surface.*

Wing of *D. pyrivora*, magnified.

The method of egg-laying is stated to be that when the Pear blossom-buds are so far advanced as for a single petal to show itself, the Pear Midges deposit their eggs within by piercing the petal with the ovipositor, and laying their white longish eggs, up to as many as ten or twelve in number, on the anthers within the still unopened blossom-bud; but, as noted at p. 88, they have been recorded by one observer as egg-laying in the open blossom. The eggs are stated to be so quickly hatched in warm weather that the little larvæ from them may be found on the fourth day after deposit. They bore into the core of the embryo Pear, where they separate and devour in different directions.

* For full and very clear description of the imago or perfect Gnat Midge of *D. pyrivora*, from which I have, with many thanks, extracted the above few points, see paper on "*Diplosis pyrivora*," by R. H. Meade, in the 'Entomologist,' vol. xxi. I have already given the above abstract of Mr. Meade's description at p. 122 of my 'Handbook of Orchard and Bush Fruits'; but it seems desirable for convenience of reference to repeat it here.—E. A. O.

The maggots are about one-sixth of an inch in length, narrow, legless, smallest at the head and tail, with a small horny appendage, known as the breast-bone, or (from its form in some of the *Cecidomyiæ* larvæ) as the "anchor process," beneath the fore part of the body near the head end. In the Pear Gnat maggot this process consists of a narrow stalk attached at its base to one of the segments of the little larva, and pointing forward at the free end, which is enlarged to nearly twice the width of the stem, and slightly notched at the flattened or convex end.

Within the Pears the midge maggots live and feed until they have attained their full size, which may be about the beginning or middle of June, and the infested Pears may often, though not always, be known by their knobbed irregular growth and discoloured patches. At this stage—that is, when the young Pear is destroyed by the mischief within—the fruit usually cracks or falls to the ground, and the maggots leave the fruit by way of the open cracks if it remains on the tree, or if it falls without cracking, may remain for some weeks within. In either case they bury themselves in the ground, and (quoting from Prof. J. B. Smith; for reference, see note, p. 91) go down to a depth "varying somewhat with the condition of the soil, from one-half to two inches, and there they lie for some time unchanged. About midsummer the larvæ make oval cocoons of silk covered with grains of sand, and in these they lie unchanged until early spring."—(J. B. S.) There appears to be a difference in date of time of the maggots forming cocoons, and turning to pupal or chrysalis state within them, possibly from not being in quite natural circumstances; but in regular course, whatever the exact date of pupation may be, the Gnat Midges come up out of the ground in spring ready to attack the blossom-buds of the Pear.

Prevention and Remedy.—One sure method of lessening recurrence of attack is to pick off and destroy the little stunted Pears before they have reached the stage at which the maggots leave them to go down into the ground. Also it is desirable to pick up (as soon as possible) and destroy the small fallen fruit. To this the treatment of giving a thoroughly good shaking and jarring of the boughs of the infested tree, so as to shake down as much of the infested fruit as possible, *as soon as possible*, would probably be a very serviceable addition. Also if previously tarred cloth, or any rough cheap material, was spread under the boughs of the tree, so that the infested fruit and the maggots which escaped from it might all be gathered up together and burnt, or well shaken out together into a hole and well covered down, this would save much escape of the maggots.

Where the ground below the trees is free of crop, and the Pear

roots not too near the surface, the plan of skimming the surface, and destroying the surface earth with its contained infestation would answer well. The depths given for presence of the cocoons are half an inch to two inches, and this might (I believe) often be safely removed. Any time would be suitable for this operation between the time of the falling of the infested Pears from the trees and such a date in the following winter or spring as would ensure that the cocoons should be skimmed off and destroyed in the infested earth before the season came for the development of the insect contents. The Gnat Midges appear with the Pear blossoms, but it would be well to be some weeks beforehand, and also to be sure that the earth is burnt, or in some way thoroughly got rid of with its contents.

Where Pears are grown in grass orchards it might be hoped that a deal of the infested fallen fruit would be cleared off by having sheep or pigs on the land to eat it as it falls.

The best remedy of which we have information at present appears to be (as reported by Prof. J. B. Smith) application of kainite to infested ground. In an observation on infested Pear orchard land in New Brunswick, U.S.A., a heavy top-dressing of kainite was applied in late summer, and under the infested trees it was applied at the rate of over half a ton per acre. The result was that in the following year scarcely any of the fruit was found to be infested; whilst in another orchard close adjoining, in which the ground had not been treated, on close examination it was found that of one kind especially grown fifty per cent. were "midged," and of the other kind named not one could be found to have escaped.

In laboratory experiment Prof. Smith found that where nitrate of soda was sprinkled in quantity that would represent a fair top-dressing in ordinary field use, on sand in which maggots had gone down, that not ten per cent. of the larvæ were alive (so far as examined) in their cocoons; and where a double quantity of the nitrate was applied, a still lesser proportion of the maggots were found to be alive.

Muriate of potash in about the same quantities showed results of respectively nearly one-half or three-quarters of the maggots dead in their cocoons.

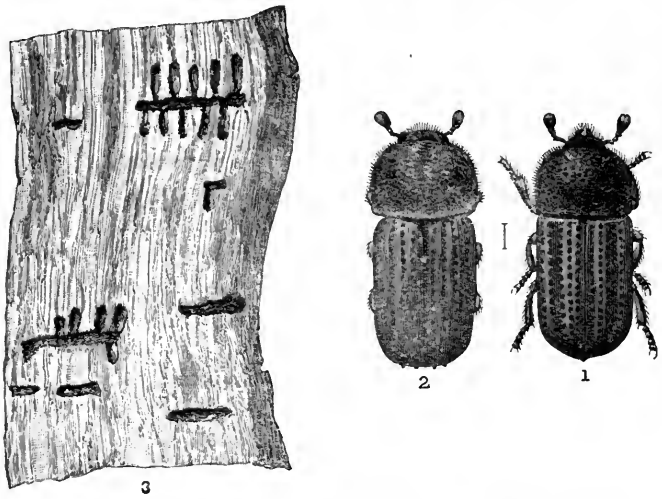
But in the case of sprinkling with a small quantity of kainite, only three per cent. of living larvæ were found in the cocoons examined; and where double quantity was used, "not one-third of the larvæ in the jar had ever formed cocoons, and those that did seemed all of them to be dead."—(J. B. S.) The experiment is given in minute detail in the Bulletin referred to below,* the period from commencement to

* See, for much useful information on this attack, "The Pear Midge (*Diplosis pyrivora*, Riley)," Bulletin 99 of New Jersey Agricultural College Experimental Station, April 4th, 1894.

final examination ranging from June 10th to October 6th, and I believe may be of great assistance to us in checking attack of this destructive Gnat Midge.

PINE.

Striped Pine-boring Beetle, *Trypodendron lineatum*, Oliv. = *Xyloterus lineatus*, Esch. **Deciduous Tree-boring Beetle,** *Trypodendron domesticum*, Linn. = *Xyloterus domesticus*, Esch.



TRYPODENDON LINEATUM.—1, male, 2, female, magnified; and line showing natural length; 3, borings in Spruce wood, natural size, showing mother-galleries and larval and pupal cells.

The two species of small wood-boring beetles mentioned above do mischief by tunnelling for a short distance into the solid timber, respectively of Conifers (in the case of *Trypodendron lineatum*) and of deciduous trees, as Oak, Beech, and Birch, in the case of *T. domesticum;* and the two species being very similar both in appearance and habits, it has seemed most convenient to give here an account in detail of the Pine-boring kind, with the addition of some notes of the distinguishing points of *domesticum*, rather than place this under a separate heading.

These attacks have not been previously reported to me, and I was much indebted to Mr. James R. Robertson (Chatsworth Estate), Edensor, Bakewell, Derbyshire, for being good enough to give me a

few observations, together with specimens of both kinds of beetles, also of larvæ and pupæ, and specimens of tunnellings of *T. domesticum* in felled Oak.

The observation of *T. lineatum* in England (as distinguished from Scotland) appears to me to be of a good deal of interest, as, so recently as 1895, I find it observed that "The species is widely distributed throughout Europe, but is confined in Great Britain to a few localities in the Tay and Dee districts of Scotland, where it has not yet proved injurious."

I find also the following by the excellent authority the late E. C. Rye, F.E.S.,* of his personal observation of it in Scotland, in wording that seems to point to his not considering it to be an English species:—

"*Xyloterus lineatus*, an elegantly striped insect, with more pretensions to beauty than its allies, is found (rarely) in Scotland. I have seen it with its head and thorax protruding from its neat circular drill in the solid wood of felled Pines; but it is oftener seen than taken, owing to its habit of backing quickly to an indefinite depth into its burrow on the approach of the bark knife. In this species the antennæ have a rounded club, whilst in the other (*domesticus*) the club is pointed."—(E. C. R.)

From the above passage, and also from only the above-named two species being noted in his list of British beetles (p. 265 of work referred to in note), it would appear that then and up to 1890 (the date of the second edition by the Rev. Canon W. W. Fowler, F.E.S.) only these two species were recorded *as British*.

But it should perhaps be just noticed that there is yet another species, the *Trypodendron* (= *Xyloterus*) *quercus* of Eichhoff, which is mentioned by him † as infesting the wood of various deciduous trees, and which is very shortly referred to by Prof. Fisher, in the work mentioned below (p. 232), as much like *lineatum* in appearance, but distinguishable by the club of the antennæ being *angulate* at the extremity. In this respect, as well as in its habits, it is stated to resemble *T. domesticum*, "but is much less common in Britain, being almost entirely confined to the neighbourhood of Sherwood Forest." ‡ From the exceedingly small amount of presence with which this species is credited in England, it seems hardly worth while to refer to it, excepting relatively to the confusion regarding the nature of trees attacked by *T. lineatum*, the *really*, *solely* Pine-boring species, which is considered by Herr Eichhoff wholly to have arisen from insufficient

* Rye's 'British Beetles,' first edition, p. 198.

† See 'Die Europäischen Borkenkäfer,' von W. Eichhoff, p. 296.

‡ See 'Dr. Schlich's Manual of Forestry,' vol. iv. p. 232, by W. R. Fisher, Assistant Professor of Forestry, Royal Indian College, Cooper Hill, &c.

discrimination between the two kinds, *lineatum* and *quercus*. And perhaps I should add that, perceiving the difficulties of perfectly certain determination, I submitted my specimens to examination of Mr. O. E. Janson, F.E.S., who verified my identification as correct.

The communications with which I was favoured by Mr. J. R. Robertson, from the Chatsworth Estate, of which the first was sent me on June 28th, were as follows:—

"I have been considerably troubled for the last few weeks by the damage being done to some Oak timber that has been felled for about eighteen months by larvæ that I think belong to the *Scolytus* or *Bostrichus* type. . . . The damage is considerable, the timber being quite riddled with small holes to a depth of two or three inches. The holes look as if they had been made with a small gimlet, and a tiny heap of small fine sawdust left at the outside of each. I am sending you by this post a box containing the larvæ *in situ*."—(J. R. R.)

About a week later—that is, on July 5th—Mr. Robertson communicated with me again, mentioning that he now observed beetle infestation of a similar nature in some felled Larch timber lying close to the Oak which he first noticed as attacked, and forwarded me specimens of pupæ, and also of the fully-developed beetles.

These beetles were in very active condition, and corresponded well with the description of the Pine-boring kind, *T. lineatum*. They are very small, only about a quarter to a third of an inch in length, and of the shape figured at p. 92—that is, somewhat straight-sided and cylindrical. The thorax punctured and black (customarily), dull yellow-brown towards the hinder margin; the wing-cases dull yellow-brown, with a black stripe running along each at the suture, the outer margin, and characteristically also along the middle; but in some cases this line or stripe is partly absent. In my specimens it was represented by some marks towards the base of the elytra. The wing-cases are also marked with rows of punctures. The legs are dull yellow-brown, as also the antennæ, which are terminated by a *rounded club*.

This species is liable to differences in colouring, and three varieties are noted by Eichhoff, of which the most distinct has the whole body pale brownish yellow, with a blackish head, and fore edge of the thorax ("Halsschild") and the breast duller.

With regard to the kinds of trees infested by this species, it is observed:—"These beetles, which live exclusively in needle-leaved trees (*Coniferæ*), are distributed over almost all Europe, and are also . . . . to be found in North America. Amongst different kinds of Conifers (*Pinus sylvestris*, *Abies excelsa* and *pectinata*, and *Larix europæa*) they appear, where they have the opportunity, to especially select the Silver Fir (Weisstanne). What Ratzburg and Altum, and to some

degree Gyllenhal, report regarding its occurrence in Birch and other deciduous-leaved trees rests undoubtedly on confusion with the preceding kind" * [namely, *Trypodendron quercus*, Eichhoff, the Striped Deciduous Tree-borer, E. A. O.].

With regard to larval and pupal description, I copy that of Dr. Taschenberg:—

"The larva is white; the place of the claw-feet being taken by six short conical lumps. The brown head is furnished with strong mandibles. As long as the larva lies in its nest, rolled together with the head near the tail, the lower part is pressed smooth, and the back arched. . . . Half of May and June, afterwards half of August, September, in wood.

"The pupa is white, slightly shining on the thorax, otherwise dull, and on both sides of the body set with 4–5 hook-like teeth directed backwards and inwardly, the foremost of these being the smallest. Length of the body 3·5 millimetres. They remain on an average fourteen days in their cradles, with the head turned towards the mother-gallery." †

So very little detail (as far as I am aware) has been recorded from original observation of the life-history in Britain of this and the allied species, *T. domesticum*, that I have thought it best to extract some of the chief points from the enormously elaborate papers of Herr Eichhoff and Dr. Taschenberg, hoping that the infestation being thus brought forward may lead to further investigation.

The method of infestation of this species to Pine timber (as given by Prof. Fisher, p. 229 of work quoted, *ante*, p. 93) is stated to be for the mother beetle to bore straight into the tree for a short distance, and then to construct one or more brood galleries at the end of the entrance tunnel, usually at right angles to this entrance burrow, and always transversely to the long axis ‡ In the floor and roof of these galleries the mother beetle gnaws small cylindrical holes vertically into the wood for the reception of the egg, and after oviposition she blocks these holes with wood-dust, forming partitions between the secondary and primary galleries. There are generally from thirty to fifty eggs.—(W. R. F.)

* 'Die Europäischen Borkenkäfer,' von W. Eichhoff, p. 299.

† The above description is taken from the elaborate account of this species given by Dr. E. L. Taschenberg in 'Praktische Insektenkunde,' pt. ii. p. 234, under the synonym of *Xyloteres lineatus*, Ol.

‡ These burrows I have not had the opportunity of examining in Pine timber, but, judging by comparison of figures and descriptions, they may be generally described as somewhat in shape like a capital Y or T laid horizontally, the stem of the letter representing the perforation of the mother-gallery made from the outside of the tree, and the arms, one of which is often missing, or very variously twisted or modified, representing the brood galleries.—E. A. O.

The figure of borings of *T. lineatum* in Spruce wood, copied from Mr. Fisher's paper, given at p. 92, conveys an excellent idea of the galleries, as seen in a vertical section of Spruce wood; and accompanying (p. 230, same paper) will be found a figure of a *horizontal* section of Spruce wood showing the entrance galleries and branching brood galleries, of which I have endeavoured to convey the appearance above by comparison with letters.

The mother-galleries of *T. domesticum* (the species infesting deciduous-leaved trees) are stated not to branch (as a rule), and in the good supply of specimens of borings of this kind into Oak timber, with which I was favoured from Chatsworth, I found that the mother-gallery, with the little upright larval cells gnawed out above and below, would be perfectly well represented by the figure of *lineatum* at heading (p. 92).

The larvæ are observable in May, and beetles are to be found about the middle of July or earlier, ready to give rise to a second brood. The specimens of *T. lineatum* (in imago state) were sent me on July 5th, those of *T. domesticum* on June 28th, and in each case pupæ, or larvæ just on the point of turning to pupæ, were sent accompanying, showing that the summer brood was then developing. It is considered on the Continent that there may be three broods in the course of the year, and that, failing other shelter, some of the last brood hybernate in moss at the root of trees.

Trypodendron domesticum, Linn., the *Deciduous*-leaved Tree-borer.—The main distinctions of the beetle, as abridged from Eichhoff's description, are that it is somewhat elongate-cylindrical, black, with straw-coloured antennæ, feet, and wing-cases, the latter with darker suture, edge, and extremity; finely punctate-striate, and furrowed on both sides of the suture at the apex. There are occasional differences in detail of colour sufficiently marked as to be classed as four varieties, but requiring with such small beetles magnifying powers to ascertain them exactly, excepting perhaps in the case of the variety of which the whole of the wing-cases and the legs are of a clear (or pale) yellow.

The life-history of this species appears to be very similar to that of *T. lineatum*, excepting in the point of it infesting the timber of deciduous (or, as they are termed, broad-leaved) trees, as Oak, Beech, Birch, and Lime; *not* that of Conifers, or "needle-leaved" trees. Also the mother-galleries do not appear to be always branched.

This species is recorded as to have been noticed even as early as February 20th in great numbers in a warm spring; but in this case it is noticed the "swarm," so to call it, would retire again, without carrying out infestation, into crevices in bark, or under moss or leaves, where the observer had often found the beetles during winter. Commonly they are stated to come out first in March, or, in a late spring,

it may be firstly in April, for breeding purposes. It is noted, however, that it is in July at the latest that (in regular course) the first generation will be found ready for flight, and then, and in August, newly-laid eggs are again to be found in the brood galleries. The beetles that thence originate from these eggs remain during winter in the place of their birth, where Herr Eichhoff notes that he has seen them often in imago state from November till March.

Prevention and Remedies.—Where the beetles of *T. lineatum* have the option, they as a rule avoid "barked"* stems for egg-deposit, especially when, at egg-laying time, the outer layer has become more or less dry. But where this is still juicy, or damp from situation, or other circumstances, then the stems which have been stripped of their bark are liable to attack. Sickly coniferous trees are liable to attack, and (with both species of beetle) broken wood and windfalls, or stumps, are particularly liable to infestation. It is therefore advised that these should be barked if their entire removal is not practicable.

Much stress is laid on removal of the bark as a deterrent of attack, but it should perhaps be noticed that in the case of this infestation the removal of the bark is only a *preventive* measure, and *not a remedy*, as it is in the case of our two great bark pests, the "Elm-bark Beetle" (*Scolytus destructor*) and the "Pine Beetle" (*Hylurgus piniperda*), in which the beetles breed just within the bark, so that removal of the nursery-ground gets rid at once of the nursery and its contents. With the wood-boring Trypodendrons, the stripping of the bark only acts by making the surface of the wood below it too dry to invite infestation.

Where the beetles are very prevalent, trees from which the bark has been taken may be attacked, and where this is to an extent that makes preventive measures desirable, this wood should be removed before March—that is, before the time of flight of the spring brood of beetles. Felling in the growing season and immediate removal of the bark is advised as a preventive.

Traps may be arranged of wood felled for the purpose, or of waste wood left about in July and August (the summer breeding-time) to attract the beetles to lay their eggs instead of infesting valuable wood. But these trees or branches should be kept under careful examination, and when found to be attacked, should be stripped of their bark and split up to destroy the larvæ in the wood.

The attacks are said to be worst where there are winter fellings, presumably from the felled tree-trunks being in favourable condition at return of spring for attack of the spring brood of beetles.

* Perhaps for foreign readers who may favour me by looking over this paper, it may be as well to mention that a "barked" stem is *not one with bark on it*, but one from which the bark has been taken.

Where the beetles are numerous the infestation is liable to cause great loss by the perforations in the solid timber, but as yet (so far as I am aware) we have not much of what may be called "commercial observation" of this in Britain, *i. e.* little complaint of damage, and (in case trouble should arise) we greatly need to have more observations *from foresters in this country*.

The attack is entered on in most elaborate detail by skilled German writers of the highest standing, but the accounts do not always wholly agree, and in my endeavour to give a reliable history of these bark beetles by collation of many publications I have met with such difficulties that I offer it under submission to corroboration in some (though perhaps not very important) points of detail to future practical *British* observation.

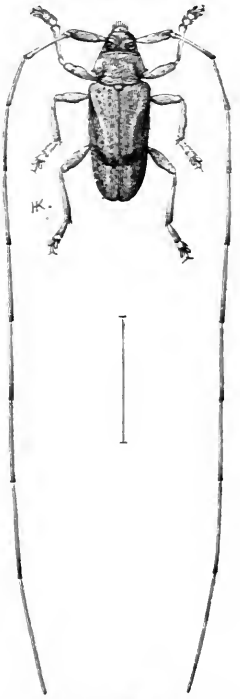
We need (I believe) notes of what the time is (in this country) of the appearance of the successive broods of the beetles; that is, what is the date in spring, and also whether besides the summer brood there is a third in autumn. Also more information as to amount of attack, and of preference of the beetles for egg-laying on felled or sickly trees, &c., and how far removal of the bark acts as a trustworthy preventative of infestation. Also there is a difference in statements as to the customary form of the brood galleries in *T. domesticum;* also as to whether *T. lineatum* wholly confines its attacks to the wood of coniferous trees. If we had information on these points from foresters accustomed to observation, so that we might know definitely what *does* take place in different localities, it would much facilitate dealing with the attack, should it prove on trustworthy practical investigation to require attention.

I may perhaps be allowed to add that, as a comprehensive digest of information up to date of publication, a very serviceable amount of entomological and practical information will be found at pp. 228-232 of Prof. W. R. Fisher's volume on 'Forest Protection,' for reference to which see *ante*, p. 93.

Timberman Beetle. *Astynomus ædilis*, L.; *Acanthocinus ædilis*, S.

This very remarkably "long-horned" beetle may perhaps deserve a slight notice again this year, as, although in almost all instances mentioned, the specimens reported were probably from imported timber, yet it is becoming a little more observed than was formerly the case.

The only specimen which I have as yet received, which might in all probability be considered of British origin, was a fine male beetle, with the antennæ (which are often injured consequently on the fighting propensities of the insects) in beautiful order. This was captured on August 12th, 1895, on the farm at Kinnaird, Strathpeffer, Ross-shire, N.B., and reached me alive, so as to give me an opportunity of studying its very graceful appearance as it walked gently about bearing its delicate horns, about half a foot in expanse from tip to tip, lightly arched at right angles to its body, of about three-quarters of an inch in length.



ASTYNOMUS ÆDILIS, slightly larger than life; line showing nat. length.

The second specimen was sent me on September 2nd, 1897, and was caught in a coalmine two and a half miles from the bottom of the shaft, and sent me from near Morpeth, Northumberland. In this case I suggested that in all probability it had been imported in timber used for workings in the mine, and my correspondent replied:—"Your suggestion that the beetle came from the north of Europe is quite correct, as the wood (Fir) used in the mine is brought from Norway."—(W. W.)

In the past season Mr. H. L. Leonard, writing on September 21st from Preston, Hull, forwarded me the third specimen, which I have received, with the remark accompanying:—"My wife caught the enclosed insect on the table the other day; no one whom I know can tell me what it is. . . . Will you kindly tell me its name, and also if it is uncommon?"

There was no entomological difficulty in identifying the specimen as being a (so-called) Timberman Beetle, *Astynomus ædilis*, L.; and in reply to my letter Mr. Leonard wrote further on September 23rd:—"I think I did not tell you that a Hull merchant found one of the same variety of beetles in his office last week. It would probably be a male, as the horns were fully an inch longer than my specimen.

If he still has it, I will get the measurement of the horns, which I fancy would be about two and a half inches long."—(H. L. L.)

The enormous length of the antennæ, and especially of those of the male beetle, are the chief characteristic of this species, of which it is stated by Dr. Taschenberg that it has in the male the longest horns which are known to occur in any European kind. In this sex they are from three or four times to as much as five times the length of the body, or, by measure, may be as much as about three and a half inches long. The horns of the female are much shorter, being only about twice the length of the body of the beetle, which may vary from about half to three-quarters of an inch.

The shape of the beetle is as figured (at p. 99, magnified) from the specimen sent me from Strathpeffer, somewhat flattish above, and the general colour of a brownish ash, or "smutty violet grey," and it is clothed with a greyish pubescence. The thorax has one blunt tooth on each side (see figure), with four much smaller ones above placed transversely in front.

The wing-cases have numerous black spots, arranged to some degree in rows, and are marked by two somewhat oblique brownish bands, the front one in the specimen figured only extended a little way from the outer edge. Legs chiefly grey or brownish, with grey down.

The beetle is found on the Continent in great numbers, and the grubs live in the wood as well as under the bark of fallen Pine stems. Also it is noted that "the larva makes wide galleries and perforations in Pine stumps, forming a nidus, with coarse gnawed fragments near the surface, in which it changes to pupa. . . . The larva appears to be full-fed at the beginning of the summer, and after remaining two or three weeks in the pupa state, changes to the perfect state, staying as such in its nest until the following summer." * The beetle is noted as being observed in great numbers after hybernation in early spring in forest clearings; and another continental observer mentions having himself taken thirty beetles in one morning in a woodyard about Pine wood.

As yet, in this country, however, the only locality where it appears to have been observed as not uncommonly present is at Rannoch, in Perthshire, and it cannot be said as yet to rank amongst the really injurious beetles of Britain. But, like the species noticed in the preceding paper, the grubs have certainly a capacity for doing mischief by feeding in fallen or felled Pine timber, and it may be well to draw attention once again to the occasional presence of the beetle as an infestation that may cause trouble.

* 'British Beetles,' by E. C. Rye, F.E.S., p. 208.

POTATO.

Potato-stem Borer. *Hydræcia micacea*, Esp.*

On July 20th, in the past season, Mr. W. Sim, of Gourdas, Fyvie, Aberdeenshire, N.B., to whom I have been previously indebted for very carefully observed notes of insect attack, forwarded me some observations of damage caused to Potato stems (to a serious extent) by the borings of a kind of moth caterpillar within them, of which he forwarded a sample.

The piece of Potato stem sent accompanying was bored for about seven inches. That is, the boring sent was about that length, but it might have been longer, as the stem was cut through at the lower part, so that some of the tunnelling was removed. At the upper part there was some frass from the workings of the caterpillar. With this, and the moth caterpillar accompanying, Mr. Sim sent the following notes:—

"I beg to enclose you specimen of larva which is not described, to my knowledge, in your works on injurious insects. They are destructive to the growing crop of Potatoes, especially in gardens, and perhaps the failure of that crop may be sometimes due to them. I have observed some extent of damage done here every season for some years, but I am not aware what is the originator of the evil. When the Potatoes are in a growing state, and the haulms nearly at the full height, a plant may be seen here and there with leaves withered up and the stem fallen over. A careful examination of the prostrate plant with hollow stem invariably shows that the damage is due to the enclosed pest, which is found feeding inside."

On August 9th Mr. Sim sent me the following communication, which it will be observed is of interest as giving the approximate date of the termination of attack:—

"I have looked over the Potato crop as you advised, and have found in the fallen stems a few more of the destructive grubs like the specimen I sent you. Their season of work is now over, but I will try and rear a moth for you."

On October 17th following, Mr. Sim was accordingly good enough to send me specimens of the moths, with the note of these moths being reared from caterpillars taken from injured Potatoes, also the date of pupation and the date of the appearance of the moths, as follows:—

"I have much pleasure in sending the Potato moths which I have

* A description of the moth, which is known popularly as the "Rosy Rustic," will be found at p. 103; but it is not figured, as the specimens (apparently from circumstances noted) were stunted in growth.

bred for you, and I have no doubt you will be able to identify them. The caterpillars of the enclosed specimens were taken in the field from injured Potatoes in the end of July, when the larvæ were about half grown. They pupated in the third week of August, and the moths appeared in the middle of September. The disease makes its appearance first in the garden among the early varieties, afterwards in the field among the later sorts. The Potatoes appear to be liable to the attack during the whole period of active growth. When late and robust growing varieties are attacked, the stems do not fall down like the earlier sorts, but may be seen standing erect after they are withered and dead."—(W. S.)

As I could not myself feel sure that I was able to identify the species quite certainly, and it was of very practical interest to be sure in the matter, I ventured to submit the specimens to Mr. Richard South, F.E.S., who was good enough to reply that he was inclined to think they were "rather small and very dark examples of *Hydræcia micacea*, Esp." Mr. South added:—"This species is known to feed in larval stage in Dock and species of *Equisetum*. So far as I am aware, the fact of this larva feeding in the stems of Potato is new, but I remember that a grower at Macclesfield told me that a 'grub' (which from his description ought to have been a *Noctua*) affected his Potato crop."—(R. S.)

On June 15th in 1892 I had myself had inquiries sent me as to the nature of an attack to Potato haulm corresponding with that reported above, and similarly caused by a *Noctua* moth caterpillar—these respectively, in one case, from Melton Mowbray; in the other, from Daleally, Errol, N.B.; but unfortunately I was not able to procure specimens of the moth to which the larva developed, for identification. From the nature of the injury, however, and the appearance of the larva, I *conjectured* the kind to be *Gortyna flavago*, a species exceedingly nearly allied to *Hydræcia micacea*, and the moths of the two species similar in size, and likewise of similar variation in size (see Stainton's 'Manual of Butterflies and Moths,' vol. i. pp. 196, 198); and at p. 119 of my Annual Report for 1892 I noted that it seemed "scarcely open to doubt," so far as I could judge from the points available for investigation, that the grubs were of *G. flavago*.

As the Potato-borer, of which we have since had specimens, proves almost certainly to be *H. micacea*, it would be of very useful interest in case Potato crops are still injured by stem-borers at Melton Mowbray, and near Errol, to have complete observation by which we might make sure of the kind specifically, and I give the following description of the larva of *H. micacea* from Newman's 'British Moths,' p. 282:—

"The body is soft, fleshy, and maggot-like, the segments being

distinctly marked, each has sixteen or eighteen minute black warts, and each wart emits a minute but rather stiff black bristle; there is a corneous glabrous plate on the second and thirteenth segments; the colour of the head is testaceous red, of the body greyish flesh colour, with a very narrow darker medio-dorsal stripe; the dorsal has more colour than the ventral surface, which has a glaucous or bleached appearance; . . . the legs and claspers are nearly concolorous with the ventral area."—(E. N.)

When three-quarters grown—that is, an inch and one-sixteenth in length—the larva is described by William Buckler * as somewhat darker in the general colouring, especially that of the upper part. "The colour of the back and sides down to the spiracles was a rather deep purplish red-brown without gloss, and a little paler on the thoracic segments and at the divisions; the sides below the spiracles, the belly, and the legs were paler, and of a dingy flesh colour; the head ochreous brown, and mandibles blackish brown; a polished pale ochreous brown semicircular plate on the second segment rather broadly margined in front with blackish brown; a small shining pale ochreous plate on the anal tip, having a terminal border of very small dark warts. . . . At the beginning of July the larva had attained an inch and three-eighths in length, . . . having meanwhile gradually grown paler on the back; and by the 10th of the month the upper and under surfaces were both alike of a deep smoky dull flesh colour. In this case the larva had fed on *Equisetum*, popularly known as 'Mare's-tails,' or 'Cat's-tails'; but at this date it ceased eating, and excavated a hole in the earth at the side of its pot, in which, by the fifteenth, it changed to a light ochreous brown pupa, three-quarters of an inch long, from which the moth emerged on the 14th of August."—(W. B.)

The moth is from an inch and a quarter to a little over an inch and a half in expanse of the fore wings, which are variously described as of a pale brown ground colour, with a rosy tinge, or of a "rich reddish brown"; on the wing is a "broad dark patch," otherwise described as a "broad median band," the outer portion being "very rich dark brown." Hind wings "whitish grey with darker central line," or "dingy grey brown with a darker crescentic discoidal spot, and transverse median bar"; the antennæ nearly white.

On communicating with Mr. Sim regarding the unusually small size of the *imagos*, which he had been good enough specially to rear for, and to send to me, he replied, on Oct. 27th:—"It is very probable that the specimens which I bred would be dwarfed, as they were only half-fed when I found them, and their food was only replaced on two occasions." But with regard to further observation, Mr. Sim con-

* See 'Larvæ of British Butterflies and Moths,' by the late William Buckler, vol. iv. p. 51. Ray Society.

sidered there would be no difficulty on this head, for the attack might be expected to occur again as it had in previous years.

In regard to measures of prevention or remedy, we do not at present appear to have knowledge of any that would be at all applicable, unless it might happen that in gardens where spraying is adopted to keep off "Potato disease," that the chemical dressing would prove deterrent if used sufficiently early in the season.

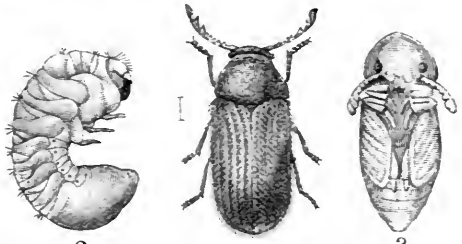
The difficulty lies in the fact of the caterpillar turning customarily (as noted in German observation) to chrysalis state in an earth-cell *in the ground* in July; from which the moth is recorded by British observers as appearing in August and September. This puts the date of development too early for breaking up the ground to be available (as a general thing) so as to throw out the pupating caterpillars. Consequently there is no obvious method of dealing with the attack as there is with *Gortyna flavago* with which the caterpillar pupates in the Potato stem.

Further information on the attack might prove also of serviceable interest *relatively to Hop attack*, as it is noted by Dr. Fletcher that a nearly allied kind, *Gortyna* (=*Hydræcia*) *immanis*, does much harm in Ontario (Canada) by means of its caterpillar boring the leading shoot of the Hops, and causing a disease known as "Bull-heads." *

* See "Notes on Injurious Insects," by James Fletcher, in 'Insect Life,' U.S.A. Department of Agriculture, vol. v. p. 125.

SEEDS, STORES, AND WOOD.

Bread or **Paste Beetle**; **Drug Store Beetle** (U.S.A.). *Anobium paniceum* (=*Sitodrepa panicea*), Linn. **Striped Death-watch Beetle.** *Anobium striatum*, Oliv. **Checkered Death-watch Beetle.** *Anobium tessellatum* = *Xestobium tessellatum*, Fab. (=*X. rufovillosum*, De G.*).



2 1 3

ANOBIUM PANICEUM.—1, beetle; 2, larva; 3, pupa, magnified. (From Bulletin No. 4, New Series, U.S.A. Department of Agriculture, p. 124.)

During the past season I received inquiry from one of our chief seed and importing firms regarding some insect infestation in Onion seed, noticed in South Africa in seed that had been imported from England. Specimens were placed in my hands for examination which showed the damage to be caused by the maggots of a small beetle, apparently some kind of *Anobium;* but (necessarily) what the species might be could not be told from merely *larval* specimens. On development, however, to beetle condition, the species was found by the Assistant Government Entomologist, Cape Colony, to be *Anobium paniceum* (now known as *Sitodrepa panicea*), a kind with which I had made acquaintance some years ago, as seriously injurious to leather of boots exported from England to Cape Town, and to Port Elizabeth, South Africa.

From the extraordinary variety of kinds of substances on which this widely distributed pest preys, it appears almost impossible to name it usefully under the name of any one of these; but as (amongst these) granary and mill stores, likewise dried Peas and Beans, are subject to its ravages, and we have now an instance of its power of injuring Onion seed, the infestation may fairly be classed amongst agricultural pests under the above heading of "Seeds and Stores," joined to that of "Wood," to which the other two species of *Anobium* named cause inconvenient or sometimes almost ruinous damage by their perforations in furniture and beams and other solid woodwork.

* Third Supplement of Henshaw List.

The figure, p. 105, gives a very good representation of *A. paniceum* in its various stages,* and may be taken as a guide to the general appearance also of *A. striatum* in its successive conditions, and to *A. tessellatum* in larval and pupal state. In beetle state this last ranges to fully half as much or more in length than the two other kinds named, and is distinguishable further by being patched or "tessellated" on the wing-cases with yellowish down, whence its specific name.

Anobium paniceum † is about one-tenth of an inch or rather more in length, of a uniform light brown colour, and covered with fine grey down. The following is a detailed description:—Oblong, convex; reddish brown, and closely covered with very fine short grey pubescence. The head is deflexed and concealed beneath the front margin of the thorax; the antennæ have the basal joint rather large, the second smaller, the six following very small, and the apical three very large and rather more than twice as long as broad. The thorax is very convex and finely punctured, a little wider than the elytra at the base, rounded at the sides, somewhat compressed in front, and slightly impressed on each side at the base. The scutellum is small and nearly square. The elytra are straight at the sides, rounded behind, and have ten impressed rows of fine punctures on each; there is also a short and slightly oblique row of similar punctures on either side of the scutellum, the interstices between the rows of punctures are flat, and have indistinct transverse scratches. In fresh and perfect specimens the pubescence is very close, and imparts a dusty appearance to the surface; there are also some longer hairs between the rows of punctures on the elytra, but in old and worn specimens the surface is frequently more or less denuded of hairs, and has a much more polished appearance. The length of the body is from three to three and a half millm.—O. E. J.‡

The larvæ are white and curved, and resemble those of other *Anobia*, and are not unlike Chafer maggots in miniature. They are soft, cylindrical, fleshy, and slightly pilose, with a scaly head (armed with robust-toothed jaws), and have six legs.

With regard to the food of the maggots (quoting again from the U.S.A. Bulletin referred to in note below, which is the fullest record

* This figure I acknowledge with many thanks as copied (somewhat reduced) from the greatly magnified figure given in 'The Principal Household Insects of the United States,' by L. O. Howard and C. L. Marlatt, p. 124. Bulletin No. 4. United States Department of Agriculture, Washington. 1896.

† *Anobium* being the name under which this genus has been chiefly referred to for many years, I continue to use it for convenience of general reference, giving the synonyms of *Sitodrepa* and *Xestobium* where requisite.

‡ See p. 13 of my small volume 'Some Injurious Insects of South Africa,' in which the technical descriptions of the insects are by Mr. Oliver E. Janson, F.E.S.

with which I am acquainted), it is said:—"In Europe it is still known as the Bread Beetle, but its chief injuries are to druggists' supplies, hence the name of Drug Store Beetle. Its depredations do not stop here, however, for it invades alike stores of all kinds, mills, granaries, and tobacco warehouses. Of household wares its preference is for flour, meal, breakfast foods, and condiments. It is especially partial to red pepper, and is often found in ginger, rhubarb, chamomile, boneset, and other roots and herbs that were kept in the farmhouse in our grandmothers' days. It also sometimes gets into dried beans and peas, chocolate, black pepper, powdered coffee, liquorice, peppermint, almonds, and seeds of every description."

Drawings, paintings, manuscripts, and books are in the catalogue of its dietary; and, again quoting *verbatim*:—"In pharmacies it runs nearly the whole gamut of everything kept in store, from insipid gluten wafers to such acrid substances as wormwood, from the aromatic cardamom and anise to the deadly aconite and belladonna. It is particularly abundant in roots, such as orris and flag, and sometimes infests cantharides." Various other subjects for depredation are mentioned, including gun-wads, likewise injury to boots and shoes, to which item I may add that I have personally (as noted further on, with a figure of injured material) only too certain knowledge of the injuries of the pest in the case of boots exported to South Africa.

The method of feeding of *A. paniceum* is stated to be that "the larvæ bore into hard substances like roots, tunnelling them in every direction, and feed also upon the powder, which soon forms and is cast out of their burrows. In powdery substances the larvæ form little round balls, or cells, which become cocoons, in which they undergo transformation to pupæ, and then to the perfect insect. . . . There may be at least four broods" [in the course of the year, E. A. O.] "in a moderately warm atmosphere." *

Amongst the subjects of attack specified above, it will be seen that "seeds of every description" are specified; and relatively to this item, the following communication was sent me on March 28th in the past season from one of our leading nursery and seed establishments:—

"May we ask your assistance in the following matter? A customer of ours in South Africa has just sent back the accompanying packet of Onion seed, which you will see is badly attacked by a weevil or maggot of some kind. When the seed left our hands last October, it was perfectly free from anything of the sort, while some of the same parcel

* I have ventured to extract the above at length as a list of the enormous variety of substances preyed on by this widely distributed pest, given on the high authority of the officials of the U.S.A. Department of Agriculture (see reference, p. 106, *ante*) cannot fail to be of great serviceableness to all who suffer from, or are called on to investigate, the ravages.—E. A. O.

remaining in our stores is still sound and good. Our client's suggestion is that the weevils must have generated in the seed; but we are inclined to think that they found their way in from the outside, seeing that the packet has been perforated."

On examining the packet of seed, I was struck with the resemblance of the little larvæ to miniature Cockchafer maggots, which is a kind of general characteristic of those of *Anobium;* and after investigation I replied that they appeared to me to be larvæ of *Anobium*, but of course of what *species* I could not say until the beetles from them developed. I was aware from previous experience that there was sometimes much mischief in Cape Colony from *Anobium* attack, and much trouble from the infestation being without cause attributed to the *exporters*. In this instance, from the high standing of the exporting firm, and the evidence as to some of the same parcel of seed remaining in their hands still continuing good, and also the fact of the seed packet returned being perforated, there appears to me to be little if any doubt that infestation was not sent in the seed from England.

With regard to identification of the species, we had the benefit of this in a communication from Mr. Claude Fuller, Assistant Entomologist of Department of Agriculture, Cape Town, Cape Colony, to whom some of the infested Onion seed was submitted for examination. Mr. Fuller wrote at length, and I extract the following notes from his letter of May 3rd:—

"During transmittal a few of the 'maggots' have matured, and the beetles prove to be the well-known 'Paste Beetle,' *Sitodrepa panicea*, sometimes referred to as *Anobium*. This, therefore, confirms the opinion of your esteemed entomologist, Miss E. A. Ormerod. In view of the fact that this insect is almost cosmopolitan, and not being acquainted with the circumstances of its delivery after leaving your stores, I can venture no opinion as to where the seeds became infested. The following reference to its food habits is quoted from a report presented to the Colonial Secretary of this Colony by the Entomologist, dealing with the injury the insect is doing to the bindings of many volumes in the Colonial Archives:—'This insect is remarkable for feeding upon a great number of substances differing greatly in character. It is a common pest in chemists' shops, feeding on dried drugs. It is not uncommon among dried plants and seeds, stored grain of various sorts, and articles containing paste. In this country it is well-known to boot and shoe merchants from the injury it does to their stock. Such injuries are reported from Australia and America as well.' Another authority says of it that 'it will eat anything except cast iron.'"—(C. F.)

At present, although this infestation is (or may be) a cause of loss to English growers and exporters by attacking their consignments of

seed, I am not aware of it as a home trouble. If it should appear here, it would be worth while to try what kinds of steeps or dressings would check progress of the mischief without lessening vitality or power of germination of the seed. Experiments on this point made by some of our large firms who have expert advisers might be very useful to themselves for communication to their consignees.

Alum has long been known as destructive to this kind of maggot, but I have no notes of its coincident effect *horticulturally* considered, and various other applications which might (harmlessly to the seed) be of service are probably too well known to need mention.

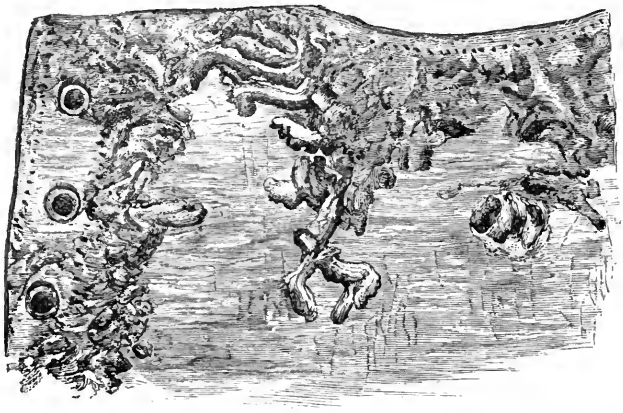
But this special seed infestation, in which the treatment would lie in skilled hands, might prove to be one in which the use of fumigation with bisulphide of carbon would do everything that is needed. We know of it as a remedial measure constantly used in Canada and the United States, and I give one of the most trustworthy recipes with which I am acquainted for method of its application to infested flour, but which would only need a little adaptation for other infested materials :—

"A small quantity of the chemical is sufficient for the disinfection of a barrel of flour, as the insects for the most part live only in the flour at the top, being unable to withstand the pressure of a large weight of material. From a half to a whole teacupful (about two to five ounces) of the bisulphide will prove sufficient for the purpose in an ordinary case, provided the cover be replaced as tightly as possible. In more severe cases of infestation it may be necessary to repeat the application. The bisulphide is poured into shallow pans, or plates, placed upon the top of the infested mass, and the receptacle covered as closely as possible, and left for a day or more. This chemical is extremely volatile and, being heavier than air, descends as a gas, killing such insects as the material may contain. When an entire room or building is overrun with insects, the bisulphide is evaporated at the rate of a pound to every thousand feet of cubic space. The vapour of the chemical is deadly to all animal life, but there is no danger in inhaling a small quantity; and although it has a powerful and disagreeable odour, this soon passes away without any after effects, and without harming for food such material as it may be used upon. The vapour is also inflammable, but if no fire, as, for example, a lighted cigar, be brought into the immediate vicinity until the fumes have entirely disappeared, no trouble will be experienced."

The above stands on the high authority of Dr. Howard, Entomologist of the U.S.A. Department of Agriculture, and Mr. C. L. Marlatt, First Assistant on the Entomological Staff; and as the advice to use this application is still regularly continued both in the United States and Canada without reports of accidents, and also, as far as I am

aware, without injury to seed, I do not feel right in not inserting mention of it. Nevertheless, I should say care was needed not only for personal safety, but also possibility of vitiating insurances.

During the years 1885 and 1886 I had a good deal of communication from manufacturers and exporters at home and recipients of goods at Port Elizabeth, South Africa, regarding injury caused to exported boots by insect-workings, which, on investigation, proved to be those of the above-mentioned beetle, *Anobium paniceum*, which was present in all its stages, larval, pupal, and as perfect insect, in the injured manufactures.



Piece of a boot injured by maggot of *Anobium paniceum*.

The above figure (taken from a portion of one of a pair of child's boots sent me as a sample of the nature of the damage) shows the appearance of the maggot-galleries, which were for the most part where paste had been used between the linen and leather, but in some places had run considerably further on. The great injury and consequent losses made the matter the subject of much consultation at the time, in the course of which I was greatly obliged to Dr. Bernard Dyer, of Great Tower Street, London, for favouring me with analyses of the ingredients used for forming paste that would be *in*-nutritious to the infestation, and therefore (it might be hoped) would be preventive of the attack.

But from the consultations of the firms being in business confidence, and involving important trade interests, I did not feel free to enter on the matter for publication at the time, and now only allude to it as another instance in which this "Paste Beetle," "Drug Beetle," "Boot Beetle" (or whatever other name it may be noted under, according to special method of attack), has a power of carrying absolute devastation before it, besides losses, and also unpleasantnesses arising

between the exporters and importers concerned as to where blame of insect infestation is to be laid.*

Two other species of *Anobium*, namely, *A. striatum*, Oliv., and *A. tessellatum*, Fab.,† do much harm by the borings of their larvæ into woodwork, including in this, damage to chairs, tables, picture-frames, shelves and cupboards, &c., and, on a larger and still more destructive scale, to floors and woodwork of roofs, &c.

A. tessellatum has especially been recorded as causing serious injury to the timbers of houses; but from the attacks of one or other species, broadscale damage may constantly be found going on, from the beginnings of the borings of the larvæ observable as little round holes hardly larger than the puncture of a very large pin, to which attention is drawn by the wood-dust falling from the galleries, up to the last stage of injury, in which the wood has been pierced and riddled until it is in a state to fall to pieces at a touch.

Inquiry is not unfrequently sent me as to methods of checking these kinds of attacks, but I am not aware that the precise method of commencement of the operations of the insect has been given, and the following observations, taken *by myself* some years ago, of the *modus operandi* in the case of *A. striatum*, may be of some practical interest, as showing that from the peculiar method of attachment of the egg to the attacked wood, application of deterrents might be given to the surface, or means used which would prevent the *fixing* of the egg which is the origin of the mischief.

It was during a few weeks in the summer of 1874 that I observed a great quantity of this species of beetle in a room at a house where I was then staying at Torquay, where it appeared in such numbers as to give me an opportunity of studying its habits, both at liberty and in captivity.

The figure at p. 105 gives a good idea of the appearance of an *Anobium* beetle seen from above; when noticed sideways, *A. striatum*, like most of its allies, will be seen to have the head much sunk into the thorax, which is raised at the hinder part in such a manner as to

* The matter will be found entered on in some slight degree of detail in my 'A Few Injurious Insects of South Africa,' pp. 14–17; published 1889.

† *Anobium striatum*, Oliv., is the species now often known as *Anobium domesticum*, Fourc. A good detailed Latin description of it will be found in the 'Coleoptera Sanctæ Helenæ' of the late T. Vernon Wollaston, p. 75, with the following short observation of some of the chief distinguishing characteristics of this species (at p. 76) as follows:—"The rather narrow outline and piceo-brownish hue of the *A. domesticum*, added to its nearly opaque and very minutely and *shortly* pubescent surface, and its small uneven laterally compressed prothorax, which is acutely margined towards the posterior angles, and obtusely carinated (or gibbose) on the hinder disk, will sufficiently distinguish it" (T. V. W.). For various synonyms of *Anobium tessellatum*, Fab., = *A. pulsator*, Schall., see heading of this paper, p. 105.

resemble a hood or cowl. The specimens I examined agreed with the descriptions of *A. striatum;* they were about a line and a half in length, although variable in this respect; *pitchy brown* in colour, and especially distinguishable to general observation by the retractile head and gibbous thorax compressed behind and triangularly raised above.

The wing-cases are reflexed round the edge of the abdomen, and are marked with longitudinal furrows (*striæ*), and covered with a short down. Beneath them are a pair of strong wings. The legs and antennæ are dull red.

*Observations regarding egg-laying and development of larvæ.**—"The place of deposit seems to be selected with great care; and in captivity the female may be observed moving about with the ovipositor extended, pausing from time to time for a few seconds to insert the extremity into any small hole suitable for oviposition, sometimes apparently simply for exploration, sometimes for deposit of an egg. Where the circumstances provided were tolerably natural, the eggs were always deposited singly, and I never noticed more than twelve inside the abdomen of the female *Anobium*.

"The eggs are white, in some degree transparent, and deposited with such a strongly glutinous secretion as to make it almost impossible to remove them from their position; this secretion probably playing a very important part in the insect economy by glueing, as it were, the egg both in the place and also in the exact position suitable, and apparently requisite, for the safe transition of the larva from the egg to its future shelter.

"The form of the egg varies from a perfect lemon-shape to a more or less irregular oval, corrugated for the most part, but not invariably all over, the small raised round spots being placed with great regularity, so as to give the smooth surface of the egg from which they rise the appearance of an even net-work of bands, each spot having a depression in the centre, and the number being approximately thirty-two in the circumference of the egg about a third from the extremity.

"Complete development of the contained larva appeared to take place in twenty-one days from the date of laying, and, under favourable circumstances, exclusion from the egg took place about the twenty-fifth day; but where the egg was unsuitably placed for the passage of the larva into its future food, it remained, through breaking the egg-shell, helpless within, or, if removed, equally helpless without (as far as its own unassisted efforts were concerned), towards forming its larval burrow. As far as I could gather from careful observation, it appeared that where the female beetle laid in unsuitable circumstances the larva was unable or unwilling to leave the egg, and it

* These notes are extracted from my paper on *Anobium striatum*, published in the 'Gardeners' Chronicle' for January 16th, 1875, pp. 86, 87.

remained within, breaking the shell, and moving restlessly about day after day. Where the egg had been placed naturally by the female beetle, the greater part remained firmly fixed as a protecting cap over the boring of the larva; the sides of the egg-shell and of the hole in which it was glued apparently giving points of resistance necessary for the support of the grub in beginning its mining operations. If removed and laid on material similar to that bored by a larva under natural circumstances, the removed grub was totally unable to form a home for itself till a little hole was bored for it to start in; then, having been placed conveniently for its future operations, as, for instance, with its head in the cavity, it at once went onwards, working itself forwards steadily and rapidly.

"The larva is white, with brown eyes and tips to the mandibles, six short legs, the head somewhat sunk in the preceding segment; the body sparingly sprinkled with long soft hairs, and the tail incurved; but in the only instance in which I was able to watch a specimen in the act of burrowing, it did not then preserve the incurved form, but stretched itself straight out whilst working."—(E. A. O., *loc. cit.*, *ante*.)

I had not the opportunity of watching the progress of development of the larvæ to beetle condition; but in the chapter on "Wood-boring Beetles," in the useful work quoted below,* it is stated:—"They become a chrysalis in their burrows, enveloping themselves in a silken cocoon, in which are interwoven particles of the dust they make. On emerging from the chrysalis they remain inactive for some time, not coming out of their burrows, and only gradually acquiring their normal colour and consistency."—(E. A. B.)

The possession of wings is an important item in the power of the beetles in distributing themselves harmfully to our furniture and woodwork; but when under observation, I found that they feigned death on being alarmed, and were usually sluggish in their habits, though occasionally temporarily brisk and moderately active.

The ticking noise, somewhat resembling the ticking of a watch, made at times by various of the *Anobium* beetles, and from which they take the name of Death-watch, is somewhat annoying, and used formerly to be the cause of a good deal of superstitious alarm relatively to its being considered to forbode a death of some member of the household. This noise, however, is not caused by the maggots, but by the beetles, and is considered to be merely a call to their mates given by strokes of the head, or mandibles on the wood, which, after a few repetitions, may be heard replied to, or even (it is recorded), if dexterously imitated, will attract appearance of beetles from the infested wood.

Anobium tessellatum (now *Xestobium tessellatum*) is distinguishable

* 'Our Household Insects,' by Edw. A. Butler, p. 7.

from *striatum* by being a good deal larger,—*striatum* ranging from about a line and a half to two lines in length, *tessellatum* from about two lines to three lines and a quarter. Also this stout little rusty or reddish-brown beetle is sprinkled on the thorax and wing-cases with patches of yellowish down, whence its name of being tessellated, and by this yellowish downy patching the species is clearly distinguishable from all the others of the twelve species formerly included in the genus *Anobium*, Fab., but now much altered in *generic* appellations. In out-of-door conditions this kind is noticed as being found in old trees, especially Willows; likewise it is mentioned by Taschenberg as occurring in woods, on parts of old stems from which the bark has been removed, most especially of Oaks; in rooms, or in houses, it is to be seen early in April at all the beams and rafters, as well as the boards in which the larvæ have bored. From the large size of this *Anobium*, it is very destructive to timber where allowed to work unchecked, and as far back as the time of Kirby and Spence the broadscale nature of its injury to the *whole* of the woodwork of houses was recorded.

The only observations of severe damage brought under my notice which were *attributed* to this species were sent me last December from Hartlepool. I was unable to procure specimens; but even should the devastation recorded not be the work of this kind, the record of such great damage where the attack of "Dust Beetles" has been allowed to take possession is of very practical interest. My correspondent asked whether there was any remedy for the ravages, adding:—

"The larva bores a small hole in the wood, generally of floors, and is a great pest here. I have seen floors so eaten away that what remained was much more like a sponge than anything else. At the present moment I am consulted with reference to the floors of a large warehouse. . . . The floor is formed of deals (Pine), three inches thick, laid on joists of the same wood, and these again on large iron girders. They are attacking the floor at present, and as to renew it would entail an expenditure of three or four thousand pounds, they are anxious to try some other remedy, if there be one."

Prevention and Remedies.—One great point is, as soon as ever it is noticed that attack is going on (which is easily observable by the dust dropped from the infested wood), to take the matter in hand without delay, *This is very important.* If nothing is done, the beetles will come out from the wood where they have developed and lay their eggs on it or any similarly suitable position at hand, and thus will continue constantly increasing destruction of property. Attention to this point is very greatly needed. So far as my own experience goes, the matter is commonly, or at least very often, allowed to run on year after year until the wood is so riddled by the workings that all strength

is gone out of it, and expensive repairs or restorations are an absolute necessity.

It should be borne in mind that, in the words of Mr. E. A. Butler (see his work previously referred to, p. 6) regarding *A. striatum* (=*domesticum*) larvæ, "no wood is so old and dry that they cannot extract nourishment from it"; and I could name more than one cathedral where carving or relics of past days are allowed to fall a prey to the so-called "Dust Beetles" with as little care being bestowed to prevent antiquarian or artistic loss, as to prevent disaster to members of the congregation who may come to trouble from seating themselves over-hastily on a chair with an overly perforated leg!

In household affairs, the best way to ascertain whether mischief is going on is to turn up the lower side of chairs and tables, and examine whether perforations such as would be made with a very large pin are present. The dust falling from the borings would be a sure guide, but it may well be that in many cases this will have been swept away, and examination may be necessary to be absolutely certain of the state of the furniture. The little holes may be found in any other part of the furniture, as the legs or backs of chairs, fronts of picture-frames, &c.; but for the most part the portions which are most out of sight appear to be preferred for attack,—conjecturally because these are most exempt from the rubbings, dressings, polishings, and other housemaids' operations, *which rub off the "Dust Beetles'" eggs, or make the surface of the wood unsuitable for egg-deposit.*

If the egg is *detached* (so far as observations go), the larva cannot effect an entrance into the wood; also the mother beetle appears to exercise such care in choosing a suitable place for egg-deposit, that it is presumable that many kinds of applications to the wood to be protected would serve for deterrent purposes.

Good rubbing with beeswax and turpentine is a very good preventive if applied in late spring or early summer when the beetles are chiefly about.

Where more thorough measures are needed, a good application of turpentine, or of furniture oil, liberally applied to the perforated surfaces, so that it may be sure to soak into the little holes, and also may make the surface unsuitable for the egg to be fixed to, is an excellent treatment. Corrosive sublimate has been found to answer well (as, for instance, applied by soaking a choice carving which it was wished to save from attack in the fluid); but *this being poison*, it is not to be generally recommended.

For general purposes, as for prevention or remedy of attack to beams, joists, or under floors in houses or farm buildings, probably tarring (early in the season, as above noted) would do all that is required to prevent egg-laying, and in farm buildings the smell of the

tar would be no objection to its use. In house work a good coat or two of strong coarse paint would certainly stop the mischief to a great extent. Whitewash is sometimes recommended, but the other above-mentioned applications are much surer where circumstances allow of their use.

Good scrubbings with soft-soap wash with a little paraffin in it would be serviceable for floors, but it should be remembered that the special season for *preventive* treatment is late spring or early summer, when the beetles are *coming out and egg-laying*.

An application called "Duresco," which is stated to be a sort of washable water-colour free from objectionable smell, has been recommended for painting over the surface of floors on which goods were required to be laid (as in large stores); but I have not as yet had a report of the results from a locality where I understand the material is being experimented with on a large scale, and I am not myself acquainted with it.

But in remedial measures against the attacks of these wood-boring beetles, the great thing is to *take them in time*. To those unacquainted with the nature of the attack, a piece of infested wood often merely looks (until the evil has been long established) as if the beams or furniture were injured by more or fewer punctures, and for the most part in the case of inquiries addressed to myself, the mischief has passed the point in which there is much hope that it can be remedied.

"Silver Fish"; "Bristle-tails." *Lepisma saccharina*, Linn.
"Fire-brat." *Lepisma domestica*, Packard, = *Thermobia furnorum*, Rov.

LEPISMA SACCHARINA, magnified (after Sir John Lubbock).

The so-called "Silver Fish" are well known to housekeepers as narrow bright silvery little creatures, about a third of an inch long,

which, when disturbed by light being thrown on them in any of their very various kinds of resorts, dash out of sight again into some concealed nook with a speed almost like the passing of a flash of light.

Though called "Silver Fish" from their bright silvery clothing of minute scales, they are not in any way related to fishes, neither are they insects. They belong to the division of *Thysanura*, which differ from insects in *not* going through a regular metamorphosis (that is, *not* through larval and pupal changes up to perfect development), and also they *never* acquire wings.

The *Lepisma saccharina* is about one-third of an inch in length, and silvery white in colour. The head is furnished with tapering horns about two-thirds of the length of the body, and the eyes are black; the mandibles (jaws) are strong and curved. The body, at the widest part, is about twice the width of the head, or a little more, and is thickest at the fore part, gradually tapering from the second segment behind the head to the tail.

Each of the three segments next to the head bears a pair of legs furnished with two clawed feet; at the tail extremity are three long bristle-shaped appendages, one pointing backwards, the two others pointing sideways at almost a right angle with the body. Propagation is by eggs.

The species was noted as long ago as 1665, in a small book published by the Royal Society, as injurious to books and papers, its general appearance being quaintly but not unaptly described as:—"Its head appears big and blunt, and its body tapers from it toward the tail, smaller and smaller, being shaped almost like a 'carret.'"

My own chief acquaintance with it was many years ago as inhabiting one or more of some deep flour-bins, holding perhaps a sack of flour apiece, in a dry warm room opening from the kitchen of a large country house; but as far as I remember, it rarely strayed to other parts of the house. Its most favourite food, as recorded, is starched clothing, linen, or curtains; also it is mentioned as sometimes doing very serious damage to silks, with the remark added that these "had probably been stiffened with sizing."

The chief cause of its depredations appears to be the attraction possessed by paste. It is mentioned that it is a serious pest "in libraries, particularly to the binding of books, and will frequently eat off the gold lettering to get at the paste beneath. . . . Heavily glazed paper seems very attractive to this insect, and it has frequently happened that the labels in museum collections have been disfigured or destroyed by it, the glazed surface having been entirely eaten off. . . . Its damage in houses, in addition to its injury to books,

consists in causing the wall paper to scale off by its feeding on the starch paste." *

From their nocturnal, or at least darkness-loving habits, it is in dark or dusky places that these creatures are especially to be found, as under pots and the like places in larders, in dark wardrobes amongst the clothes, or in crannies of woodwork, or, again, on library shelves; and in German observation it is noted that in August the "Fishes" are to be found in their haunts of all sizes, pointing thus to summer time being the season of their multiplication.

The communications sent me, with specimens accompanying, from time to time have not added anything to the already known points of their history, and the means of prevention or remedy are suggested by their habits. These appear for the most part to turn on such measures as frequent moving of all vessels in larders amongst which the "Fishes" might shelter, shaking out clothes, well clearing out all crannies in wardrobes, and moving books on shelves, or laid where it is likely the creatures may have hidden themselves. In library prevention it is said that pyrethrum powder sprinkled on the shelves is of use; and where woodwork is not in order, it could not fail to be of service to fill up all chinks and crannies thoroughly. Where the infestation is to such an extent that wall-papers are loosened by the depredations, it would certainly be worth while to spread cloths or some material smeared with some tenacious substance at the bottom of the wall, and then taking the paper down piecemeal, and carefully, let the "Fishes" fall, and thus be captured. If after this the wall was repapered with some ingredient obnoxious to insect (or rather to "Silver Fish") life, mixed with the paste, and not hurtful to tenants of the room, the trouble might presumably be soon got rid of.

Until about six years ago, *L. saccharina* was considered to be the only species of the genus found in England; and in the 'Cambridge Natural History' (volume published in 1895, p. 186) is the observation:—"*Thermobia furnorum*, our other British Lepismid, has only recently been discovered; it is found in bakehouses at Cambridge and elsewhere. The bakers call these insects Fire-brats, apparently considering them to be fond of heat."

In the United States Bulletin published in 1896 (referred to in the note below) this species, given under the synonym of *Lepisma domestica*, Packard, is mentioned as having "become very common, particularly in the last year or two, in England and on the Continent." Of this it is said: "This species closely resembles the common 'Silver Fish' in size and general appearance, but may be readily distinguished from it

* 'Principal Household Insects of the United States,' p. 77. Bulletin No. 4. New Series. United States Department of Agriculture, Washington. 1896.

by the presence on the upper surface of dusky markings"; and a very good figure is given accompanying the description.

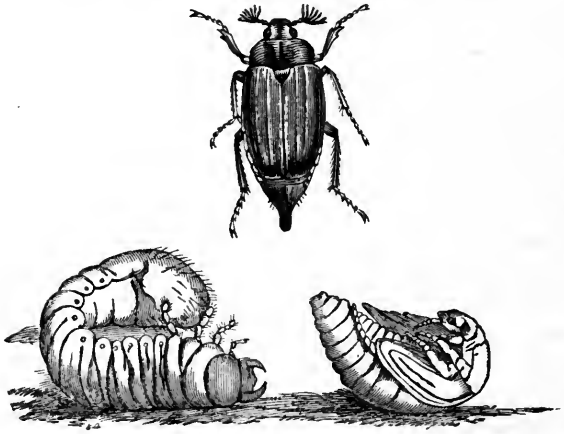
This species is stated to differ from our long-established kind in having a great love of hot localities. It is stated to frequent ovens and fireplaces, and seemingly to revel in an amount of heat which would be fatal to most other insects. "It disports itself in numbers about the openings of ranges and over the hot bricks and metal"; and it is mentioned that "the habit of this species of congregating in bakehouses and dwellings, about fireplaces and ovens, has given rise to the common appellation for it in England of 'Fire-brat.'" It is further mentioned that the creature possesses well-marked differences from the "Silver Fish," which have led to its late reference to a distinct genus—*Thermobia*. "An Italian entomologist, Rovelli, has described this insect under the descriptive name *furnorum*, from its inhabiting ovens, and the name of the genus to which it is now assigned by English entomologists is also descriptive of its heat-loving character."

The earliest description, that I am aware of, of this "bakehouse species" is that by Packard in 1873, under the appellation of *Lepisma domestica*, and with mention that it was common about fireplaces at Salem, Mass., U.S.A.

I have not myself seen specimens of this kind until last season, when in a consignment of "Silver Fish," part of the sample was so distinctly different from the rest in the matter of being much patched with grey on the back, that I think it must have been of this *L. domesticum* = *Thermobia furnorum*, but I had not the opportunity of identifying technically at the time, and therefore cannot be certain.

STRAWBERRY.

Cockchafer. *Melolontha vulgaris*, Fab.



MELOLONTHA VULGARIS.—Common Cockchafer, maggot, and pupa.

The attacks of Cockchafer grubs to roots of crops, whether of grass in pastures, to which they are exceedingly injurious, or of what may be more especially known as root crops, as Turnips and Mangolds, or Potatoes, up to mischief to the roots of young trees in nurseries, are only too well-known; but they are not often reported in this country as injurious to Strawberry plants. In the past season, however, I had just a few observations sent me (with specimens accompanying) of damage caused to a troublesome extent by the attack of these grubs to Strawberry plants in the early summer.

The first was sent me on May 28th regarding attack to a field of Strawberries of about two acres in extent planted in the previous autumn near St. Germans, Cornwall, and was a short note as follows:—

"I send herewith a specimen of a grub that is eating off my Strawberry plants just below the surface of the ground; it takes them clean off, just like a knife. What kind of grub is it? and is there any remedy?"—(J. P.)

On June 16th Mr. S. J. Wilde, writing from Elm Lodge, Englefield Green, Surrey, sent the following observations, with a sample (showing the damage to be caused by Cockchafer grubs) accompanying:—

"I lost a good many Strawberry plants last year, and am doing the same this year, by the grub of which I send you a sample. My gardener says it is the grub of the Cockchafer. I should be much obliged if you say the same, and also if you can tell me what to do to prevent the nuisance."

The above notes, it will be seen, only give two reports of attack of these special pests; but in one case the damage was considerable, as it extended over two acres of ground, cutting off the tops of the attacked plants as if with a knife; and in the other, the attack was a recurrence of mischief of the previous year. Little (if anything) has been reported in previous years of this kind o damage to Strawberry plants in this country, although on the Continent of Europe injury to Strawberry roots by Cockchafer grubs is amongst one of the regular attacks, and it is possible that by drawing attention to the matter it may be more fully observed and counteracted.

The Cockchafer beetle, figured at p. 120, must be too well-known to require description. Its reddish brown wing-cases make it a conspicuous object when at rest, and its powers of flight in the evening, when the large and powerful wings, folded beneath the wing-cases during the day, are brought into active service, and direct attention very thoroughly to the presence of the beetles.

To get rid of these, shaking them down during the day, when they are dull and sluggish, from the leafage on which they cling until the evening hours call them out in search of their mates, is the best remedial measure. To prevent their escape, hand-picking immediately; or shaking down on cloths, from which they may be directly swept up into vessels with some sticky stuff in them which will prevent the Chafers flying away; or having pigs at hand, which will eat the beetles greedily; or boys who, for a very small sum, will (with great pleasure) trample on the Chafers, and collect the bodies at some very small sum per quart: all are practicable measures.

The females lay their eggs in the ground at a depth variously stated as from two to four, or from about six to eight inches below the surface of the soil. These eggs, it is considered, hatch in about a fortnight, and the grubs, it is usually recorded, live (as they do in their older conditions) on roots of grass or other plants. It has, however, been *said* that in their first season after hatching the grubs do not feed on roots, but on *humus;* but whether this is so or not, I cannot myself say. They feed during the warm part of the season for three or more years, going down in winter to a greater or less depth according to circumstances; and at the end of the third or fourth summer go down to a depth *stated* to be two feet or more. Here they change to the perfect condition, the Cockchafers making their appearance early in the following summer.

The lowest depths by measurement from which Cockchafer grubs have been sent me were five to six inches below the surface. They had not been further down, because they were always found at the bottom of their burrow. This was at the beginning of the month of February.

Sometimes the grubs may be found present in great numbers in a given area. In the past year Mr. Thomas Forbes, of Swinton, Masham, Yorks, favoured me with a note of having in January observed great numbers of the larvæ of the Common Cockchafer when having pits dug [for tree planting]. The pits were made nine feet apart, and on an average nearly eight of the Cockchafer grubs were observed in every pit. This would show an amount of infestation present in the ground very capable of doing serious mischief to any roots suitable for grub ravage.

The grub, when full-grown, is of the shape and size figured at p. 120, whitish and fleshy, with the abdomen rather enlarged towards the extremity, and tinged with a bluish colour, consequently on the excrement showing through the skin. The yellowish horny head is furnished with strong jaws, and each of the three segments behind the head bears a pair of long reddish legs; the usual position is (as figured) lying on one side, and somewhat curved together. In the pupal state, also figured, it resembles the beetle, with the immature forming limbs folded beneath the body.

For prevention of attack, destroying the beetles when they appear in large numbers (as mentioned above) is of service, but destruction of the grubs when established in such places as Strawberry beds would be exceedingly difficult.

As a matter of precaution, where large areas of Strawberries are being planted (as mentioned at p. 120), it would be worth while for someone *personally interested in the matter* and also acquainted with the appearance of the grubs, to have some trial holes dug, about six inches deep, here and there in the ground which it is intended to plant, so as to ascertain whether the ground is clear of the infestation before trusting the plants to it.

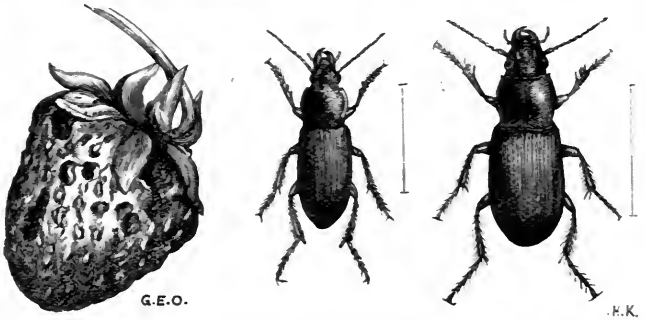
Traps have sometimes been found to answer made of sods of grass. These, it is mentioned, were cut eight to ten inches broad, and six to eight inches thick, and laid (grass surface downwards) on the surface of the ground *in the autumn*, and during examination in July of the following year, the "turf-traps" afforded 16,000 grubs. The extent of area is not stated, but the diminution of amount of pests and broadscale proof of the plan being practically useful is worth notice.

It is neither likely nor to be desired that the expense of *preventive* measures should be gone to, unless there is good reason for believing grub infestation to be present; but this plan of "turf-traps" might be well worth trying as a *remedial* measure when Cockchafer or other Chafer grubs are found to be doing mischief. Also it might be well worth trying whether "traps" of less elaborate formation, such as pieces of slate, or tile, laid by the plants, might not serve sufficiently

well for a shelter as to keep the grubs from burying themselves, and thus a daily search make clearance possible.

Wild birds, such as rooks and sea gulls, should on no account be driven off. The black-headed gull will follow the plough in the same manner as the rooks, and feeds on Cockchafers both in grub and beetle stages; and the beaks of these or other of the larger birds, which are adapted for piercing into the ground, will remove larvæ which lie within their reach without injury to surrounding rootlets, which would be caused by horticultural disturbance.

Ground Beetles—"Bat Beetle." *Harpalus ruficornis*, Fab.; *Pterostichus* (= *Omaseus*) *vulgaris*, Linn., and other species.



HARPALUS RUFICORNIS (left hand), and PTEROSTICHUS VULGARIS (right hand), magnified, and lines showing natural length. Strawberry fruit gnawed by *H. ruficornis*.

All Strawberry growers on a large scale will probably be only too well acquainted by report, even if they have not suffered under it themselves, with the very great damage now too often caused yearly by the large black or pitchy black beetles figured above (magnified) to Strawberry fruit just at the ripening or ripened stages.

The attack was first recorded as seriously destructive in 1894; since then it has greatly extended in area, and become (in the districts affected) a cause of great loss to Strawberry growers, and of annoyance, though on a less important scale, to private owners, whose plots were robbed by the beetles instead of affording fruit for household purposes.

The history of the attacks has been successively given in my Annual Reports for 1894, 1895, and 1897, with descriptions of the different species of "Ground Beetles" which caused the damage, and so much of their life-history as we are acquainted with. Also at pages 64–68, preceding, under the heading of "Mangolds—Ground Beetles," an account will be found of the attack of various of the same

species as those that injure Strawberries to Mangold roots, with a figure of *Pterostichus* (=*Steropus*) *madidus*, a kind found especially present at the roots; and also figures showing the manner in which Mangolds were eaten off below the top of the root.

The beetles are for the most part about half an inch or rather more in length, although one species, *Calathus cisteloides* (not figured, but much like the others in shape), is smaller, being only from about a quarter to half an inch long. The colour is for the most part black, although, in the case of *Harpalus ruficornis*, it *appears* to be of a yellowish tint, from the wing-cases being covered, whilst the specimens are still fresh and uninjured, with a golden or greyish down. This kind also differs from the others noticed in being furnished with *ample wings*, usually folded away under the wing-cases, but which are sometimes freely used for flight of such large numbers of the species on summer evenings, that their numerous appearance is described as a "swarm." The other two of the larger kinds of beetles have the wings *entirely wanting;* in *C. cisteloides* the *wings are wanting*, or imperfect.

Full details of all information sent up to date will be found in my Annual Reports for 1894, 1895, and 1897; and a condensed account giving the chief points in my 'Handbook' of injurious fruit insects and remedial measures published in 1898. But amongst these it was only during the course of last year, and too late for insertion in my Annual Report for 1897, that we had information as to what is really the most important part of the whole matter practically; that is, observations of measures that could be trusted to for preventing beetle attack, or for checking it when present. Therefore I refer again to the infestation in order to insert these, of which the two first are especially valuable, as giving accounts, on excellent authority, of very successful use of easily carried out broadscale measures of trapping and destroying these fruit pests.

Prevention and Remedies.—It was on July 19th in the past season that Messrs. Laxton (Brothers), of Bedford, were good enough to write me as follows, and, on my request, granted me permission to make use of the information with their name appended:—

"We are pleased to be able to report that we have almost entirely destroyed the beetle pest which played such havoc with our Strawberry crop last season. We purchased a large quantity of cheap pudding-basins, early this spring; these are let into the ground, level with the surface, at distances of a few yards apart, and kept them baited with pieces of lights and sugar-water. When the weather was dry we often caught half a basinful of a night, until the number gradually diminished to two or three, and now none at all. It is a laborious process, but

well worth the trouble, as we have lost no fruit this season.—(Signed) Laxton Brothers."

The trouble and expense of this method of treatment is so very inconsiderable compared to the great losses where beetle ravage proceeds unchecked on the ripening fruit, that I strongly recommend it to the attention of all concerned, as well as the following simple and successful method of getting rid of the wasteful pests, for which I am indebted to the courtesy of Mr. Lewis Castle (Manager), Woburn Experimental Fruit Farm, Ridgmont, Aspley Guise, Bedfordshire. After mentioning in his letter of February 28th of the past year that a year or two since they had been greatly troubled with these Strawberry beetles, Mr. Castle observed:—

"I obtained a number of empty condensed milk-tins, placed about half an inch of tar in the bottom of these, and plunged them in the soil by the plants to the level of the rims. Enormous numbers were caught in this way, and for two seasons we have not been seriously troubled with them."—(L. C.)

Two special points in the habits of the beetles which it is desirable to bear in mind relatively to preventive measures are,—one, that *they are nocturnal* in their habits, and seek shelter during the daylight hours in cracks in the ground, or in the earth close to the attacked plant, even under the bunch of fruit which they have been ravaging, making their way down through the litter and straw placed round the plants. Another point is that these Strawberry feeders do *not lose their carnivorous propensities*, and may be attracted by meat.

Relatively to the first habit, another method which, if too expensive for broadscale growing, answered excellently on the smaller scale of a private garden, was mentioned to me by my friend and neighbour, the Rev. J. A. Cruickshank, as having answered thoroughly in saving his Strawberries in the Vicarage garden at Sandridge, near St. Albans, from *Harpalus ruficornis*, which had done much mischief there the previous year, and had again appeared. The ground amongst the Strawberries was covered, as is customary, with straw, and the plan adopted by the gardener was to remove the straw from a space, and then, trowel in hand, turn over the surface of the ground temporarily laid bare, and secure the sheltering beetles. Thus, gradually going in this way through the bed, the beetles were captured by hundreds, and whereas the first part of the crop was ruined, afterwards (when the plan was carried out) the fruit was saved from further ravage.

Relatively to utilizing the carnivorous habits of the beetles, it has been reported that "flesh covered by pieces of thick sacking attracts a number, which are easily killed." It will be observed that in Messrs. Laxton's method of trapping the basins were partially baited with pieces of "lights." Conjecturally speaking, I should suppose any kind

of spare waste meat would answer equally well, for in my own *indoors* observations, I found that *Harpalus ruficornis* and *Pterostichus vulgaris* would feed willingly (as a variety on Strawberry ravage) on live worms, uncooked mutton, cooked meat and fish, and bread. Probably the meat or fish would be the most attractive by reason of the stronger and more widely diffused smell.

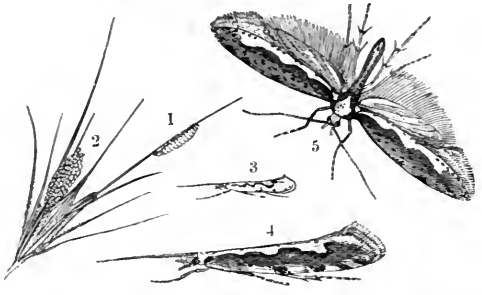
At present we need for completion of the life-history of the beetles some observations of method of life of their grubs, of which, so far as I am aware, we have no descriptions, but which may be presumed to resemble others of the *Geodephaga*, that is, the Ground Beetles, in their appearance and habits. These are stated to be mostly found in the same places as the perfect beetles. In shape "they are usually flat, elongate, parallel-sided, fleshy, with the head and first segment hard; . . . the legs are horny, six in number, and situated on the first three segments; there are short jointed antennæ and palpi, and powerful *sickle-shaped* jaws, and the apex of the body has usually two horny or fleshy appendages on its upper surface, the lower part being lengthened into a membranous supplemental leg." *

In the case of the three kinds of Ground Beetles which are wingless, it appears certain that the grubs (or *larvæ*) must either feed in the ground near the plants, or be brought there in soil or enrichments, and it is possible that if we knew whereabouts in the earth the grubs are to be found, and how deep they lie for their pupal changes, we might be able to bring some preventive measures to bear on them also.

* 'British Beetles,' by E. C. Rye, pp. 44 and 46.

TURNIP.

Diamond-back Moth. *Plutella cruciferarum*, Zell.; *Cerostoma xylostella*, Curtis.



PLUTELLA CRUCIFERARUM.—1, caterpillar; 2, eggs; 3–5, Diamond-back Moth, natural size and magnified.

Since the memorable appearance of Diamond-back Moth caterpillars in 1891, and a lesser, although injurious, appearance in the following year, the infestation has not appeared in sufficient numbers (excepting a moderate amount of presence in 1894) as to call for a special report, and in one only of the intermediate years (1896) up to present notice, has inquiry been sent to a sufficient amount even to allow of its name standing in the list of insects noticed during each year. In the course of the past season (1898), however, I have received some small amount of observation of the infestation from one North British locality, which is of practical interest as once again referring to attention being drawn to the presence of the moth caterpillar on Turnip leafage, by the concourse of sea gulls busy amongst what, on investigation, proved to be infested crop.

On July 7th of the past season Mr. W. D. Anderson, writing from Ardsheal, Ballachulish, Argyleshire, N.B., kindly sent me the following note:—

"Again, I regret to say, the Diamond-back Moth is attacking our Turnips. As in previous years, the presence of a flock of sea gulls on the crop led me to inspect it closely. The leaves showed the markings and holes characteristic of the ravages of this pest, but I searched for some ten minutes before I came on the caterpillar herewith enclosed. I think it has begun to spin. . . . Whilst writing this letter, the caterpillar has moved out of what appeared to me the beginning of a cocoon."—(W. D. A.)

The specimen sent was certainly a caterpillar of the Diamond-back Moth (*Plutella cruciferarum*). These are only about half an inch long

at full growth, and tapering slightly to each extremity. The colour is variable, usually of a delicate or apple green; but in younger state the caterpillars are often yellowish or greyish, with black head. When near full growth the head is usually grey or yellowish, and marked with small black dots; the next segment is remarkable for the *absence* of the two dark patches often found in the case of small caterpillars of allied kinds, and instead has a number of very minute black specks. The rest of the segments have a few black dots. Each of the first three segments bears a pair of claw-feet, and there are also four pairs of sucker-feet beneath the body, and another pair (which are very noticeable from being set out somewhat obliquely) at the extremity of the tail.

When full-fed, which may be in about four weeks, the caterpillars spin their cocoons for the most part at their customary feeding-place, the *under side* of the leafage of their food-plants, or on stems, &c., near. These cocoons are sometimes a mere open net-work of white threads, through which the colouring of the chrysalis can be distinctly seen; and, so far as I can judge from the many specimens which passed through my hands in 1891 (the year of the great attack), there is a good deal of variety in this matter. The characteristic colour when mature is whitish with some black streaks; in the early part of their formation the chrysalids may be green or brownish, and sometimes the cocoons, instead of being a mere open net-work of white threads, are thicker, and of a somewhat boat-shaped form.

The moths may come out in from about one to three weeks from commencement of the chrysalis state, and are of the size given at "3," p. 127. The front wings are long and narrow, greyish brown along the centre, and fore edge, with some small brown spots in front; a rather broad whitish or ochreous grey band runs along the hinder margin, so shaped along its fore edge that when the moth is at rest, with the wings laid along the back and their edges meeting, the pale patterns form a row of diamond-shaped markings, whence the name of Diamond-back Moth (see figures 4 and 5, magnified, p. 127).

There may certainly be two broods during summer or autumn, and the chrysalids from the latest brood of the year remain in this state through the winter.

Returning to the special point of sea gulls, and also of the kinds of sea gulls noticed on infested land, it was in 1894 that Mr. W. D. Anderson, whose note I give at p. 127, preceding, favoured me with the following observation regarding their presence at the same locality, namely, Ardsheal, Ballachulish, Argyleshire, N.B., during the month of August. Mr. Anderson remarked:—

"My attention was first drawn to the field where the caterpillar was discovered by a large flock of gulls (herring gull, common gull,

and kittiwake) that had settled on *one-half of it*, and seemed to remain there day and night. I never actually detected them eating anything; on the contrary, they seemed to be wandering about in rather an aimless way."—(W. D. A.)

On examining the condition of the crop, however, Mr. Anderson found that the Diamond-back Moth caterpillar was very plentiful on the half of the field occupied by the gulls; whilst he was only able to find one or two specimens on the portion of the field which was neglected by the birds. Also it was mentioned that about eight miles south of the locality there was a similar occurrence with a blighted crop, the farmer attributing the destruction of his Turnips to the ravages of the gulls.

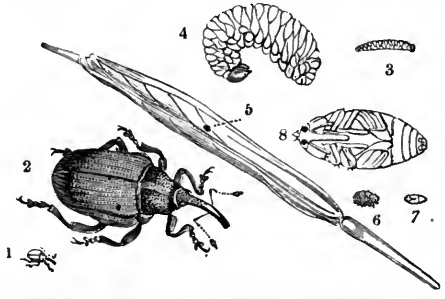
In the case of this infestation, birds of several kinds play such a very useful part as remedial agents, that, as it is possible I may not have such an appropriate occasion again of drawing attention to it, I refer now specially to the matter, and to the great importance when flocks appear in large numbers of (not only) *not* driving them away, but also of instituting careful search beneath the Turnip leaves to see whether infestation is present and needs looking after.

Besides the sea gulls, which were also noted from Lancashire as frequenting some Diamond-back-infested land in great numbers, and also doing service at a locality in Northumberland, starlings have been especially noticed as useful. This bird is more repeatedly reported as a helper against the caterpillars than any other kind, the notes constantly recurring that,—starlings frequented the infested land; starlings in flocks were noted feeding; many starlings when we had the caterpillars; starlings are especially useful in clearing the caterpillars; starlings present in thousands; and also that starlings had done much good.

Other birds were also mentioned as doing good, and amongst them the Lapwing, or Peewit (*Vanellus cristatus*); but in the great attack of the Diamond-back Moth in 1891, which (besides other localities) was present in the counties along our eastern seaboard from Dover in Kent to Aberdeenshire in North Britain, the replies to the question sent out in my official circular of various inquiries as Entomologist of the Royal Agricultural Society regarding what kind of birds helped in the great trouble, specified the starling as by far the most serviceable.

Details of the attack, with some means of prevention and remedy, and much other information, will be found in my Annual Report for 1891, pp. 105–164.

Turnip-seed Weevil. *Ceutorhynchus assimilis*, Payk.
Turnip and Cabbage Gnat Midge. *Cecidomyia brassicæ*, Winn.



CEUTORHYNCHUS ASSIMILIS.—1 and 2, beetle; 3 and 4, maggot; 7 and 8, pupa (all natural size and magnified); 5, infested Turnip pod.

The causes of loss to Turnip-seed growers from attacks to seed, accompanied by distorted growth and premature yellowing and cracking open of the pods, have for many years been the subject of inquiry. The damage is referable to two quite distinct kinds of infestation, one being that of the Turnip-seed Weevil, figured above; the other of the Turnip and Cabbage Gnat Midge, *Cecidomyia brassicæ*.

The Seed Weevil has been repeatedly mentioned before, especially in 1891, but is just referred to again in order to point out the differences between it and the "Gnat Midge," and their respective methods of attack to the seed. The little beetle is not quite the sixth of an inch in length, including its (comparatively) long and curved proboscis. When freshly developed, it appears to be grey, owing to the coating of grey or whitish hairs with which it is covered; but when these are rubbed off, it is black. There are two broods in the year, of which the second lives through the winter, and the beetles, which have great power of dispersing themselves, from the ample size of their wings, feed on flowering shoots of Turnip, Rape, Mustard, or allied plants. The maggots feed on the seed within the pods, and by a little careful watching may be seen in the act of preying on the seed with their little brown jaws, and the seed in various stages of consumption, from a small piece having been eaten to the whole of the seed being cleared out of the skin by the maggot still within, and wet green rejectamenta, the result of feeding, lying at the caudal extremity of the maggot shows that the devouring of the seed is then going on.

This method of feeding, that is, the *consumption of the substance of the seed*, is an easy way of distinguishing the attacks of the weevil maggots from those of the maggots of the Gnat Midge, which do *not eat up* the seed, but destroy it by *suction*, so as to cause the seeds to shrink and sink in.

The weevil maggots are distinguishable by being (as figured at p. 130, magnified) fleshy and legless, transversely wrinkled, yellowish white in colour, with brown or pale brown heads, and when full-grown, only about half an inch long. When full-grown, and consequently on the premature opening of the seed-pods, they fall to the ground, and bury themselves for their change to pupa or chrysalis (see figure, p. 130). This is of a dull ochreous colour, with black eyes; the pupal state continues for about three or four weeks in the summer.

The above notes are only given for convenience of comparison with that of the Gnat Midge without the trouble of special reference; some detailed notes will be found on the attack, together with that of the Turnip-flower Beetle, *Meligethes æneus*, in my Annual Report for 1891, accompanied by observations of some moderately successful methods of prevention of damage, and in 1897 I again mentioned it, together with the attacks of the Gnat Midge.

On July 20th in the past season Mr. W. Sim, of Gourdas, Fyvie, Aberdeenshire, N.B., who had communicated with me regarding presence of this Turnip-seed pest in the two preceding years, wrote me again as follows:—"The larvæ of the Turnip-seed Midge are again very destructive with us. I will write you again" (W. S.). On August 9th Mr. Sim continued:—"My crop of Yellow Turnip seed is almost a complete loss. Last year the damage done was very extensive and disappointing, so I had the roots planted last autumn in another field. The strong healthy foliage and rich blossom in the spring showed every indication of a full crop, but the seed-pods were scarcely formed when they began to turn yellow by the attack of myriads of the midge maggots. Now, when the crop is cut, the damage can be ascertained, and I must be content with stones of small worthless seed in place of hundredweights. The disease made its first appearance on the 1st of July, and some of the larvæ were full-fed and began to escape three days afterwards. A few handfuls of the infested seed-pods put in sterilized earth, and covered over began to give birth to the midge about the middle of July, and by the end of the third week they were issuing forth almost in clouds every time the covering was removed. This destructive pest is likely to be overlooked, and other causes attributed to the loss and failure of the crop, as only those that are giving the subject their close attention could believe and estimate the amount of damage. Swedes have seeded well, and, though not absolutely clear of the midge maggot, are a good average crop. The Turnip-seed Weevil has given little trouble this year."—(W. S.)

The larvæ, or maggots, of the Gnat Midge (that is, of the *Cecidomyia brassicæ* of Winnertz, which these appear to be) are easily distinguishable from those of the Seed Weevils by the heads being so

very small as not to be observable without strong magnifiers, nor armed with strong mandibles. The shape is somewhat oval or parallel-sided, lessening to the head and tail end. The length three-quarters of a line or slightly more; colour milk-white with a yellow food-canal; the surface has the appearance of being granulated, and the hinder edge of the *penultimate* ring is edged with bristly hairs.

The anchor process—that is, the small somewhat anchor-like organ present in *Cecidomyia* larvæ, placed beneath the body near the head end—was unusually difficult to find; but on long investigation I found the stem (by the end of which it is attached to the larva) was parallel-sided for about three-fifths of its length, and then swelled out, the free extremity being about twice the width of the stem, flattened at the end, and *slightly* notched.

These maggots (it is noted by Dr. J. Ritzema Bos) "are to be found in the last half of May and in June in Rape-pods, and may be found in great numbers even up to forty or fifty in one pod, where they suck the unripe seeds to such an extent as to destroy them before the time of ripening. The pods swell at the maggot-infested spots, and ripen and wither also earlier than those which are uninfested, and burst open, and the larvæ fall to the ground, where they change to pupal state. In about ten days a swarm of little Gnat Midges make their appearance, and these again lay eggs in the pods, which are to be found at the upper part of the stalks of Rape or other cruciferous plants." *

The perfect insect or Gnat Midge of *Cecidomyia brassicæ* is gnat-like in shape, but very small, rather less than the twelfth of an inch in length, with head and back of thorax dark or black with silvery hair; the abdomen flesh-coloured, usually with brown or black bands. Legs black, silver white beneath, turning lighter after death. Wings transparent flesh-colour at the base, very brightly iridescent; the fore edge black, as also the veins; and the first long vein very near the edge.†

This species turns black after death, and though it appeared to me that the specimens sent me might be presumed to be of this species, I could not be absolutely certain; still, judging also from the similarity of the larvæ, and the habits, including some of the additional points in these reported as above by Mr. Sim in his observations of the past season, it seems to be scarcely open to doubt that it is *Cecidomyia brassicæ*, Winnertz.

Prevention and Remedies.—As yet we do not seem to have knowledge of any practicable preventive or remedial measures, but yet there

* 'Tierische Schädlinge und Nützlinge,' von J. Ritzema Bos, p. 588.

† For full description of perfect insect see 'Fauna Austriaca: Die Fliegen (Diptera),' Schiner, vol. ii. p. 374; and also 'Praktische Insektenkunde,' Taschenberg, pt. iv. p. 8.

are some that might be worth trying. The larvæ are very small and tender, and as in the case of the very nearly-allied Cecid of the Pear, *Diplosis pyrivora*, dressings of kainite sprinkled on ground where the larvæ have gone down have been found to act extremely well in destroying a very large proportion of the grubs before their change to the pupal state, there does not seem to be any reason why a dressing applied when the maggots are leaving the pods might not answer equally well in checking the Turnip as the Pear-blossom Gnat Midge.*

It should also be noticed that there is a *second brood* of Gnat Midges, which breed in the pods at the end of the shoots. It may certainly be considered that the first infestation of each year arises from the *C. brassicæ* which have wintered from the last brood of the preceding season, probably in larval or pupal condition.

This point is what we need especially to lay our hands on for preventive treatment. Cutting off and destroying these small ends of shoots with the small pods would pay well by checking coming infestation if attack was found present. Also, from careful observation, such as that of Mr. Sim, we might learn in what state the pests pass the winter, and thus know with certainty whether they could be dealt with by dressings or other agricultural treatment in the ground to which the larvæ dropped from the pods.

* Reference to this application will be found under the head of Pear Gnat Midge, p. 91, preceding, with mention also of other dressings effective in preventing development of larvæ.

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TO MISS ORMEROD'S

ANNUAL REPORTS OF OBSERVATIONS

OF

INJURIOUS INSECTS.

LONDON:
WEST, NEWMAN AND CO., PRINTERS,
54, HATTON GARDEN, E.C.

GENERAL INDEX

BY

ROBERT NEWSTEAD, F.E.S.

Curator of the Grosvenor Museum, Chester,

TO

ANNUAL REPORTS OF OBSERVATIONS

OF

INJURIOUS INSECTS

1877—1898.

BY

ELEANOR A. ORMEROD, F.R.Met.Soc.

FELLOW ENT. SOC. LONDON; HON. FELLOW ENT. SOC. STOCKHOLM; MEMBER ENT. SOC. WASHINGTON, U.S.A.
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WITH PREFACE BY THE AUTHOR.

LONDON:
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1899.

PREFACE.

It is now twenty-two years since the series of Annual Reports to which the following Index refers were commenced by the issue of a short illustrated pamphlet, entitled "Notes for Observations of Injurious Insects," in which it was suggested that great service would be rendered towards checking the ravages of crop insect pests if reliable information could be procured as to preventive and remedial measures which were practically and on good authority found to be of use, together with coincident details bearing usefully on the subject.

For this purpose notes of some of the points which appeared of most importance for practical observation were given in the circular, together with short descriptions, and the best figures then attainable of about fourteen kinds of injurious insects which were selected for observation (just by way of making a beginning), and information was requested from agriculturists and entomologists conversant with the subject, on these or other crop infestations, for publication in a Yearly Report, of which copies were to be sent for acceptance by each contributor.

Subsequently the attention of all inclined to contribute information was especially drawn to the circumstance, that even the very shortest note of treatment known on good authority to be serviceable would be acceptable, as thus (working on year by year) we should collect a reliable mass of information, which might after a time be arranged continuously and in order, so as to give available records of the best known remedial treatment of the most troublesome crop pests *of* this country, from observations taken *in* this country, and therefore adapted to the needs of our climate and agricultural arrangements.

The idea was at once adopted, and in the twenty-two years in which I have been honoured by the information of our agriculturists, fruit-growers, and foresters being entrusted to my hands I have endeavoured in each successive Annual Report to give all the main points of information forwarded to me, taking care that (as far as lay in my power), both in honesty to my contributors, and also for satisfaction of my readers, all contributions should be accompanied by the name and the locality of residence of the sender, and (where practicable) also given in the original wording.

My own part of the work has been correspondence on the subject; identifications of the insects; including in difficult cases reference to entomological specialists, from whom I have never failed to receive kind assistance; and yearly arrangement of information received, with additions of accounts of life-history and habits, and also figures of the insects, often drawn expressly for the purpose; and also additional accounts of means of prevention and remedy where these were desirable and attainable, and issue of these in form of an Annual Report, of which acceptance of copies was requested of contributors and colleagues.

The following list gives a few short notes as to insect infestations which have been more especially reported on in the course of the series, either on account of unusually great prevalence in the year referred to, or because of their being customary farm troubles of serious importance; or, in some instances, on account of their presence in this country as farm pests not having been previously recorded. The year of Annual Report, and reference to pages, are appended to each note :—

Silver Y-Moth, *Plusia gamma.*—Great infestation of this moth, beginning early in June, from swarms which had been traced across the Continent, starting from the north-west of Africa in April; dates and localities of advance given. Threatened mischief from the destructive caterpillars stopped near Maldon, in Essex, by persistent downpour of rain (1879, pp. 4, 5).

"**Turnip Fly**" or "**Flea Beetle,**" *Phyllotreta nemorum*, and other species.—The year 1881 was remarkable for the prevalence of "Turnip Fly" in twenty-two counties of England, and eleven in Scotland. The loss by calculation of cost of seed, and cultivation for successive resowings on area of acreage estimated to be infested, at lowest calculation £503,952, irrespective of consequent losses by depreciation of stock (1881, pp. 47–97).

Wireworm, grub of **Click Beetle,** *Elater* (*Agriotes*) *lineatus*, and other species.—Estimates of losses caused by attack; measures of prevention by treatment of pastures before breaking up, also of cultivation, dressings, and remedial treatment generally to check or lessen loss from attack (1882, pp. 22–63).

"**Antler Moth,**" *Charæas graminis.*—Outbreak of caterpillars on grass and plants on an area of ten miles (from east to west) of the Glamorganshire mountains (1884, pp. 15–18); also on grass of seven of the counties in the south of Scotland, doing great harm in hill pastures (1894, pp. 12–23).

First report on **Ox Warble** (1884, pp. 101–122).

"**Hessian Fly,**" *Cecidomyia destructor*, first appearance of, as a corn pest in this country. My own examination of the infested Barley near Hertford, and identification of the fly from specimens reared by myself from the infested stems, with confirmation of my determination by British and American entomologists (1886, pp. 10–26; and Appendix pp. 101–105). Also in the following year, accompanying

unusually warm weather, much increased appearance of the infestation, ranging in a more or less broad band along the east coast from Kent in the south of England to Cromarty in the north of Scotland, besides other localities, with maps of infested areas; identifications of parasites by Dr. Lindeman (Moscow) and Prof. C. V. Riley, Entomologist of the Department of Agriculture of the U.S.A. (on my own application to them) as being, with the exception of one species (which occurs on both continents), *all of Russian, and none of American kinds* (1887, pp. 12–54).

"Beet Carrion Beetle," *Silpha opaca*.—First recorded as a crop pest in England; in this case, to Mangolds (1888, pp. 91–96).

Orchard Insects (**Winter Moth,** *Cheimatobia brumata*, and other kinds).—Preventive treatment by "sticky banding," &c., spraying with kerosine emulsion; and introduction of spraying with Paris-green as a remedial orchard treatment in this country (1889, pp. 56–84).

Orchard Moth Caterpillars (**Winter Moth,** *Cheimatobia brumata*, and others).—Formation of the Evesham Committee of Horticultural Experiment, and notes of treatment and success of spraying with Paris-green given in detail; and notes also on London-purple (1890, pp. 74–106).

Diamond-back Moth, *Plutella cruciferarum*.—This infestation appeared in vast numbers both in England and Scotland in the summer of 1891, but was chiefly prevalent (as was the case with some other of the unusually great attacks noticed) along the eastern counties. Great damage was done not only from destruction of leafage of Swedes and Turnips by the caterpillars, but by their thus being prevented or retarded in bulbing. The observations contributed from many localities give detailed information, especially on amount of loss, preventive and remedial measures, and kinds of birds sometimes helpful in clearing the caterpillars (1891, pp. 105–164).

Wasps, *Vespa vulgaris*, and other kinds.—This year (1893) was remarkable for an enormous amount of Wasp presence, causing boundless annoyance, and also some damage to horses from their attacks where nests were ploughed up, and considerable loss was caused to fruit-growers. The prevalence of the infestation was worst in England, but was reported as being also troublesome in various parts of Scotland (1893, pp. 111–140).

Ground Beetles, *Pterostichus madidus*, *Harpalus ruficornis*, first report of, as injurious to Strawberry crops by devouring the ripe fruit (1894, pp. 93–97). The attack of these and some other species of Ground Beetles became much more prevalent in the following year; and in 1898 some good remedial measures were brought forward.

Horse Forest Fly, *Hippobosca equina*, habits, &c., of, with observations on peculiar appendages of the foot, and two plates showing their structure (1895, pp. 95–118).

Angoumois Moth, *Sitotroga* (*Gelechia*) *cerealella*.—Grain infestation imported in Barley from North Africa (1897, pp. 13–21).

Currant Gall Mite, *Phytoptus ribis*, history of, from first special record of presence in England in 1869; life-history, &c., of; and considerations as to preventive measures (1897, pp. 141–158).

Horse Forest Fly, *Hippobosca equina*, observations of, in a district of Glamorganshire and adjacent part of Brecknockshire, thus giving an additional locality of infestation to those previously recorded (1898, pp. 50–56).

Pear Gnat Midge, *Diplosis pyrivora*.—First record of widespread presence in this country since first observation in the year 1883 (1898, pp. 84–92).

The above notes refer to only a few of the more remarkable infestations which were noticeable on account of their great area of presence; or for being previously unrecorded in this country; or for their great injuriousness where warmth and drought of longer duration than is customary here favoured insect development, and was detrimental to vegetable progress.

Space does not allow of entering here on the great part played by weather influence in fostering or in checking great amount of insect presence; but the injurious devastations of leafage caterpillars early in the summer of 1896 coincidently with heat and drought; and, on the other hand, the immense numbers of the caterpillars of the Silver Y-Moth which were destroyed in Essex in 1879 by a persistent downpour of rain in the month of August, are examples of two very important kinds of effects of weather influence.

Reference to the Index will show many instances in which (especially in the case of various fruit insect pests) the various points of life-history have gradually been observed and recorded to our great benefit by scientific entomologists.

Bird presence as an insect protection has been much entered on, showing the benefit in ordinary circumstances; also the great benefit in *extraordinary* amount of insect infestations of the *extraordinary* amount of birds that flock to our aid. Also we have record of how even where insect injury had not previously been noticed as being in progress, attention has been helpfully directed to it by the gathering of birds to the fields. All kinds of birds which are even moderately insectivorous may be considered as helpful to an amount which makes up for occasional mischief (so long as they are not in overwhelming numbers), EXCEPTING THE HOUSE SPARROW, *Passer domesticus;* but that this bird is a national evil rests on well-proved observations.

Agricultural measures for lessening amount of insect presence, such as in many cases can be carried out in regular processes of cultivation, are entered on throughout the series of Reports; and amongst these are especially such breakings up of soil as will *throw out insects* (surface caterpillars, for instance) from their self-made winter shelters to cold and wet; and also (on the other hand) the beneficial use of the skim-coulter in

some cases in turning the top slice of land with its insect pests *thoroughly down* so as to bury these away. Chemical dressings of various kinds, which have come greatly more into use at the present day for farm service than twenty-two years ago, are much recorded as beneficial insecticides, especially gas-lime; nitrate of soda as injurious to Daddy Longlegs grubs, besides its excellences as a stimulant acting rapidly on crops requiring support in insect attack; and kainite also has been found useful in preventing small larvæ just below the surface of the ground coming to development.

The main points recorded of our chief attacks given in the Annual Reports up to 1891 I have condensed into connected papers in my 'Manual,' published in that year. Much increased attention has since then been given to orchard and bush fruit growing, and the contributions on this subject are given (brought up to date) in my 'Handbook of Orchard and Bush Fruit Insects,' published in the autumn of last year (1898).

With respect to the great mass of correspondence and reports which have accumulated year by year in my hands. Many of these, for various reasons, are of no public importance, and these I have not preserved. But there are a very large number of letters and communications which are of great value as being identifications and reports regarding rare forms of insect infestation, on which consultation was needed, contributed to me by many of the most leading entomologists, British and extra-British, of our time; and also there is a very large amount of practical information contained in communications, varying in length from short notes up to regular reports, regarding habits and means of lessening loss from insect ravage, which have been contributed by well-known agriculturists, fruit-growers, and foresters; almost all of these bearing the name and address of observer, and date of communication. These I have carefully preserved in a collection of many volumes as being an unbroken series of practical and scientific record, extending over a period of two-and-twenty years, of conditions bearing on appearance or methods of counteracting presence of insect pests in the peculiar climatic and other conditions of our island, which is of no very large area of mileage, and isolated by its sea-girt state from most kinds of extraneous infestation, save such as are chiefly conveyed in grain and other trade imports, or are windborne to our shores. These documents might very likely have been more serviceably utilized year by year in more skilled hands than mine, but they could have been in none more desirous to make them of the fullest service; and in the belief that they are an important national trust, I have, in the dispositions of my will, bequeathed the papers where they will be in safe and honest keeping, both with regard to their preservation, and also that if the stores of information contained in them should be further utilized, it will be acknowledged rightfully to the observers.

For myself (as I have mentioned in the Preface to my Twenty-second Annual Report), so long as health sufficient for the work is granted me, and I am honoured by being asked to assist, it is only a pleasure to me to endeavour to do my very best, and I hope to continue to publish yearly results, but with a little difference in the plan, so that I may utilize *short notes* of useful means of prevention and remedy sent me, *in a separate section* following the body of the Report, and under a distinctive heading. Thus I hope we may gather up *all* information sent, but without encumbering the Reports with *repetition of figure and description*, save where necessary. With these slight differences (and all being well) I propose to commence a new issue as a "Second Series."

With regard to assistance in the work, which is increasingly becoming more than can be dealt with by one person, I have much help in secretarial matters from my resident lady secretary, Miss Hartwell; but in much press of application and occasional illness in the past year, I have found need of a scientific entomological colleague to whom, in order to save delay, I might apply as occasion required, to give desired information to applicants, and also who would oblige me by co-operation in extreme cases of minute microscopic investigation.

I have therefore, through the kind courtesy of Mr. Robert Newstead, Fellow of the Entomological Society, Curator of the Grosvenor Museum, Chester (who has for some years contributed from time to time information of valuable interest to my series of Annual Reports, and by whom the accompanying Index has been compiled), made arrangements with him which, by permitting me to communicate with him if occasion arises, remove my fear of difficulties occurring on the above heads, and give me great satisfaction, as I have long been acquainted with his careful insect investigations, and his great powers of microscopic observation and delineation, for examples of which I may refer to the forthcoming volumes on *Coccidæ*, prepared by him for publication by the Ray Society.

ELEANOR A. ORMEROD, F.E.S.

Torrington House, St. Albans:
October, 1899.

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EXPLANATION.

The plan of reference adopted in the following General Index is to give, after each entry, the year of the Report, with page reference following, thus :—

Abraxas grossulariata, 1877, 16, 17; (&c.)

Following this are the details, each year of reference occupying a separate paragraph, thus :—

On White Ribes, 1877, 16; (&c.)

In the Plant Index (p. 43), the Animal Index (p. 57), and the Index to Unclassified Hosts (p. 58), the ordinary English names of the hosts are indexed, the scientific name follows. By "hosts" is meant the plant, animal, &c., which is the special subject of infestation of the various insect attacks. The infesting insects are mentioned previously in the General Index. These special indexes are given to facilitate identification of an attack.

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* The above series of entries—from "Attacks, range of, in England and Scotland, 1881," to "Water, use of, to press on first growth," inclusive—are extracted from my Special Report on the great attack of "Turnip Fly" in 1881; and—though placed under the head of the species *nemorum* of the *Haltica* or *Phyllotreta*, on account of this being one of our most common kinds—are not to be considered as referring exclusively to this species. In the great area infested by *Haltica* (known as Turnip Fly, or Flea Beetle), other species of the genus were doubtless present, though not often mentioned, and the notes of habits, and preventive and remedial measures are equally applicable to the whole of the infestation known as "Fly" or Flea Beetle.—E. A. O.

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ANIMAL INDEX.

INDEX TO UNCLASSIFIED "HOSTS."

S.

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